ART FOR BEGINNERS SERIES

HOW TO MAKE MODERN JEWELRY

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FOREWORD

HOW TO MAKE MODERN JEWELRY is the second book in the Art for Beginners Series based on methods and techniques which have proved outstandingly successful in the War Veterans' Art Center.

The original idea of an Art Center for the rehabilitation of veterans was introduced by Mrs. John D. Rockefeller, Jr., in the early days of World War II. Through her interest and sponsorship, in co-operation with Stephen C. Clark, a comprehensive program of the arts and crafts was made available free of charge to men and women who had served in the armed forces and Merchant Marine of the United States.

The Center was opened in October, 1944, and closed in June, 1948. During the four years 1,485 veterans attended its classes in painting, sculpture and ceramics, jewelry, woodworking, industrial design, design, graphic arts,. silk screen printing, lettering and layout, wood engraving and book illustration, and orientation.

The ART FOR BEGINNERS SERIES was adopted and authorized for publication by the War Veterans' Art Center Committee to make the methods and techniques of the Center available to others.

Others in the Series are:

HOW TO MAKE POTTERY AND CERAMIC SCULPTURE

HOW TO MAKE OBJECTS OF WOOD

In preparation:

HOW TO DRAW AND PAINT

This book designed by Charlotte Trowbridge and Carlus Dyer

INTRODUCTION: Art for Beginners Series

This series of publications is designed as a means of self-instruction for the beginner in learning the fundamentals of the arts and crafts. These publications are prepared for use at home, in schools (high schools and colleges), in community centers, and for therapeutic work in hospitals. The books are intended as self-instruction manuals for persons working on their own, and as aids to the trained teacher in directing large groups. While it is recognized that there is no substitute for the teacher, it is believed that these books written by teachers and containing their experiences will help beginning teachers and students in the arts and crafts in gaining a sound point of view and producing satisfactory results.

The aim of the series is to develop creative power along with fine craftsmanship. While the beginner is taught to make objects, he is also urged to create his own designs, and guided into thinking of design as an integral part of construction.

This book is designed to help beginners learn how to make jewelry in sterling silver and other metals. It contains eighteen graded projects, all of which are based on hand construction and a minimum of hand tools. Most of the tools required are simple and not expensive with the exception of a blowtorch or kiln in Projects XIII and XIV. A motor-driven polishing wheel is suggested, but the hand buffer will do adequately for all the projects. A complete novice can start with the first project, while one with more experience may choose projects equal to his interest and skill.

All the photographs showing processes were taken of veterans at work and the finished products, unless otherwise noted, are from the jewelry classes of the War Veterans' Art Center. Most of the examples of professional work are from the exhibition MODERN HANDMADE JEWELRY, arranged by the Museum of Modern Art, others bear the credit line on the photograph. Drawings and diagrams are by Charlotte Trowbridge. Photographs, except those otherwise labeled, are by Soichi Sunami. Most grateful thanks are offered to Ralphine White for her reading of the text before publication and for her co-operation and that of Irving Gotthelf in preparing the process photographs. Both Miss White and Mr. Gotthelf are veterans and attended the jewelry classes of the War Veterans' Art Center. The directions and diagrams for making a jeweler's work bench on page 94 are reprinted from SILVER FOR THE CRAFTSMAN, through the courtesy of Handy and Harman. The list of materials on pages 10 and 11 are adapted from the same catalog.

HOW TO USE THIS BOOK

A few words of direction may help the beginner to use this book more effectively. It is intended that the beginner should start with the first project and proceed to the later projects which become more advanced as he gains experience. Each project is introduced with the materials, tools and supplies to be used in making the particular piece of jewelry described. In cases where the materials, tools, and supplies have been used in a preceding project they are not repeated, but reference is made to the project where they are listed.

Emphasis is made throughout the book on how to design. This is as important as the techniques of construction, as it is hoped that the beginner will develop his own jewelry, otherwise the whole object of the book will be lost. The true craftsman is always a designer.

The beginner is advised to read each project through before attempting to do any work. Then it is suggested that he lay out all the tools and materials needed for the project, reread the project, and then do it, checking with the text and the figures illustrating the process as he proceeds.

ORDERING STERLING SILVER

Sterling silver may be had in sheet, circles, strip, and wire, according to your needs. Although sterling silver is sold by the troy ounce, craftsmen find it more convenient to order it by dimensions. However, you must give *all* dimensions—length, width, and gauge or thickness. If you order by the ounce, it is still necessary to give the gauge and width.

In this book thickness is indicated by Brown and Sharpe (B & S) wire gauge, which is a standard gauge for this purpose in the United States, and the one used by most craftsmen. Weights listed for any particular B & S gauge are close approximations, due to very slight variations in thickness of sheet and wire customarily allowed in rolling, drawing, and cutting.

Unless otherwise specified, silver comes to you annealed or soft. It can also be supplied in various tempers with a spring quality for sections or units demanding strength but requiring no soldering, such as pin tongs and clips. These tempers are called: HALF-HARD, which means there has been a reduction of two gauges without annealing; HARD, four gauges; and SPRING HARD, six to ten gauges. The higher the gauge of hardness, the closer the metal is taken to its elastic limit.

SHEET Sterling silver sheet is available in all standard gauges and in widths up to fifteen inches, or even wider for special orders, but the gauges below are some of the ones most commonly used by craftsmen. Blanks can be supplied in all gauges and dimensions. Practical sizes are 12" x 6", 3" x 6", 6" x 6", etc.

Sheet form is suggested for bezels because it can be cut into various widths as needed. Some craftsmen prefer fine silver for bezels. This may be had in the same gauges as sterling.

B & S Gauge		Weight per sq. inch troy ounces
12	for very heavy rings and forged bracelets	.443
14	for heavy rings and bracelets	.351
16	for average rings	.278
18	for lightweight pierced designs	.221
18	for bracelets, earrings, beads, buttons and bezels for settings, etc.	.221
20		.175
22		.139
24		.110
26		.087

CONVERSION TABLE: Equivalents in decimal fractions of inches of B & S gauges mentioned here:

B & S Gauge	Thickness in Inches	B & S Gauge	Thickness in Inches
4	.204	17	.045
6	.162	18	.040
8	.128	19	.035
9	.114	20	.032
10	.102	22	.025
12	.081	24	.020
14	.064	26	.016
15	.057	30	.010
16	.051	32	.008

WIRE Although wire may be had in all standard gauges, the following are most commonly used by hand craftsmen. When ordering round, square, or half-round wire give two dimensions. gauge and length.
This section is reprinted from SILVER FOR THE CRAFTSMAN, courtesy of Handy and Harman.

Round B & S Gauge	Square B & S Gauge	Half-Round B & S Gauge
9	8	5/16" base
12	12	6
16	14	10
18	18	15
20		
24		

WHERE TO BUY MATERIALS AND TOOLS

The following sell almost everything needed for making jewelry. Orders are taken by mail for those not within reach.

Anchor Tool and Supply Co , 12 John Street, New York 7, New York

William Dixon, Inc., 32 East Kinney Street, Newark 2, New Jersey

Patterson Brothers, 15 Park Row, New York 7, New York

The following sell the items listed:

ENAMELS

B. F. Drakenfeld & Co.
45 Park Place
New York 7, New York

John T. King Co.
147 Chestnut Street
Providence, Rhode Island

Maas and Waldstein Co.
440 Riverside Avenue
Newark 4, New Jersey

Thomas C. Thompson
Wilmette, Illinois

Zapon Co.
Stamford, Connecticut

FINDINGS

Ajax Findings Co.
682 Sixth Avenue
New York 10, New York

Federal Findings Co.
365 Atwells Avenue
Providence, Rhode Island

General Findings and Supply Co.
Leach and Garner Building
Attleboro, Massachusetts

Magic Novelty Co.
132 West 21 Street
New York 11, New York

Metal Crafts Supply Co.
Providence, Rhode Island

Newall Manufacturing Co.
29 East Madison Street
Chicago, Illinois

METALS: Brass, Copper, Nickel Silver

T. E. Conklin Brass and Copper
54 Lafayette Street
New York 13, New York

Revere Copper and Brass, Inc.
230 Park Avenue
New York 17, New York
and
1215 Industrial Trust Co. Building
Providence, Rhode Island

Standard Rolling Mills
143 Jewel Street
Brooklyn 22, New York

METALS: Gold and Silver

Cummings, Gilbert & Co.
2800 Frederick Road
Baltimore 23, Maryland

Eastern Smelting and Refining Corp.
107 West Brookline
Boston, Massachusetts

Goldsmith Bros. Smelting & Refining Co.
58 East Washington
Chicago, Illinois

Handy and Harman
82 Fulton Street
New York 7, New York
and
3625 Medford Street
Los Angeles 33, California

I. Miller, Inc.
304 Colonial Arcade
Cleveland, Ohio

Wildberg Bros. Smelting & Refining Co.
742 Market Street
San Francisco 2, California

POLISHING MATERIALS

Arrow Supply and Tool Co.
27 West 20 Street
New York 11, New York

STONES

William A. Mercer
665 Fifth Avenue
New York 22, New York

Metal Crafts Supply Co.
Providence, Rhode Island

G. A. Veeck, Inc.
315 Fifth Avenue
New York 16, New York

TANKS AND TORCHES

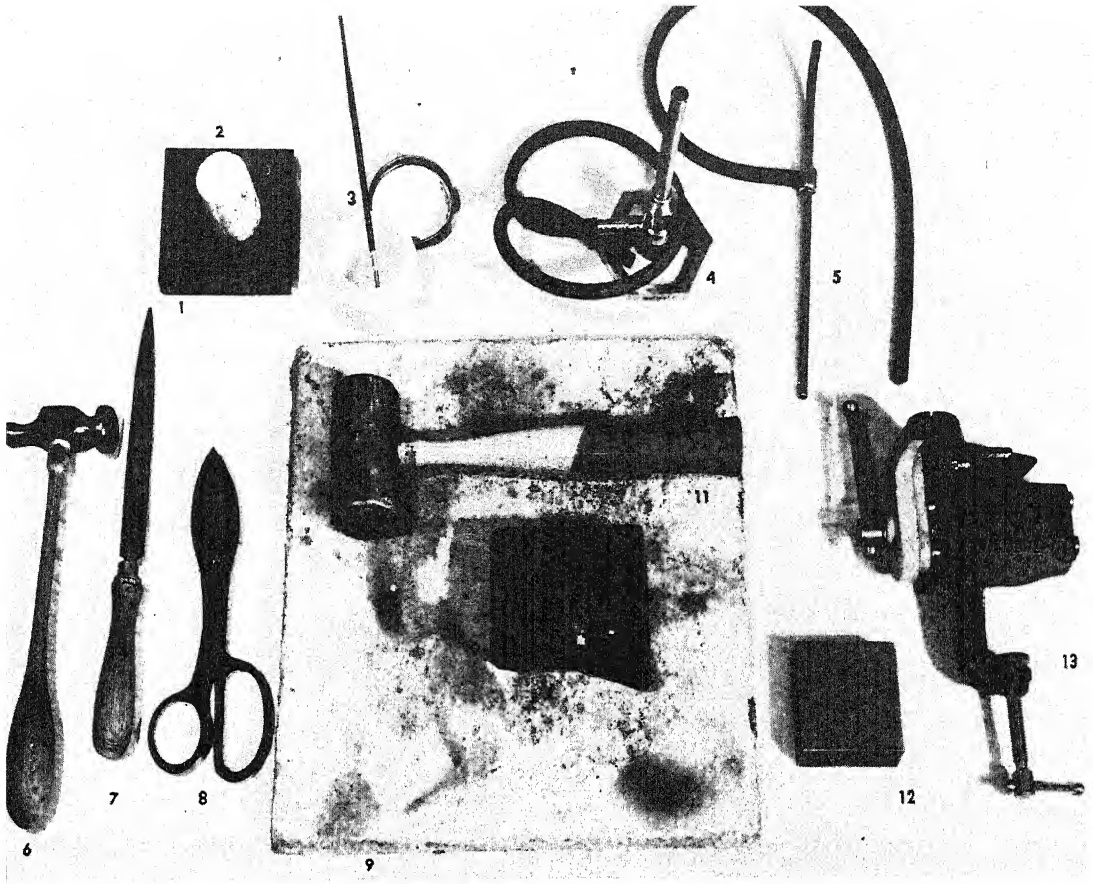
The Prest-O-Lite Co., Inc.
30 East 42 Street
New York 17, New York

TOOLS

Ernest Linick & Co.
29 East Madison
Chicago, Illinois

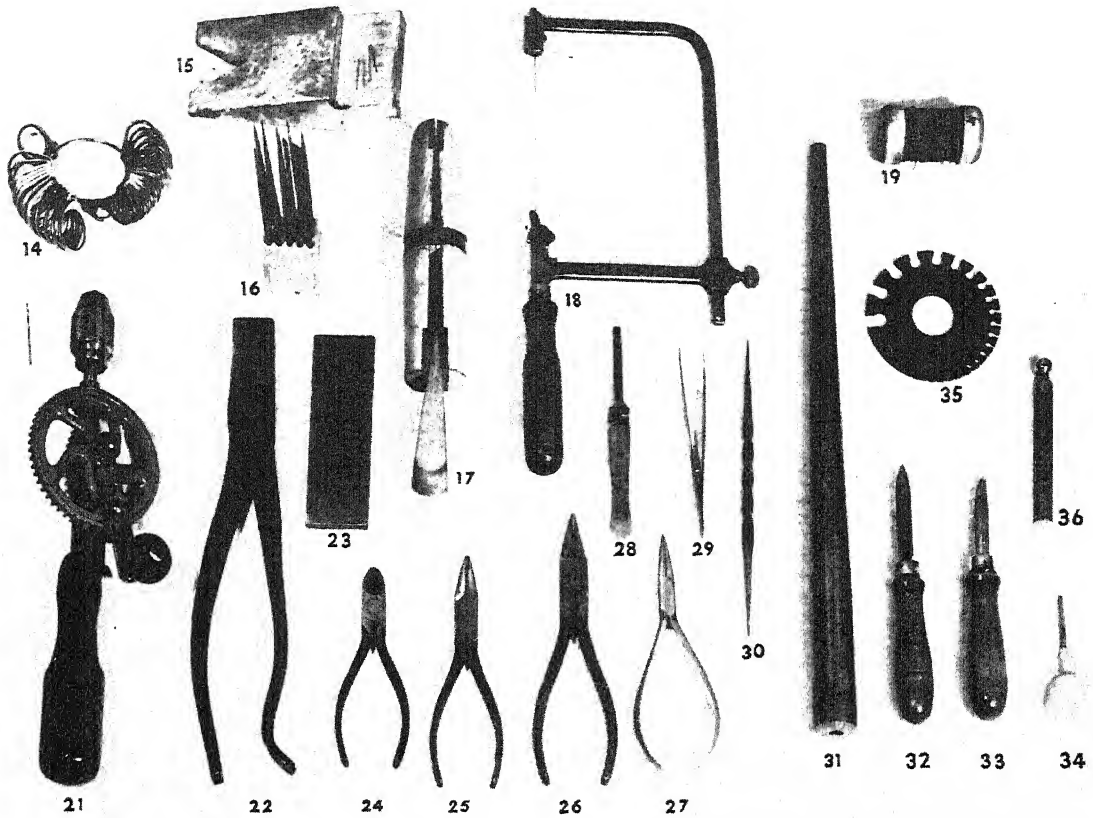
Metal Crafts Supply Co.
Providence, Rhode Island

Norton Co.
Worcester, Massachusetts



BASIC TOOLS USED IN JEWELRY MAKING

1. Borax slate
2. Borax stick
3. Flux brush
4. Bunsen burner
5. Blowpipe
6. Chasing hammer
7. Half-round file
8. Metal snips
9. Asbestos block
10. Charcoal block
11. Rawhide mallet
12. Steel block
13. Bench vise
14. Ring gauge
15. Bench pin
16. Set of needle files
17. Ring clamp
18. Saw frame with blade in place



19. Binding wire
20. Twist drill
21. Hand drill
22. Draw tongs
23. Drawplate
24. Side-cutting nippers
25. Flat-nose pliers
26. Round-nose pliers
27. Chain pliers
28. Soldering tweezers
29. Tweezers
30. Scriber
31. Ring mandrel
32. Scraper
33. Curved burnisher
34. Pusher
35. Wire gauge
36. Dapping tool

Ball pein or machinist's hammer not illustrated

TOOLS AND SUPPLIES FOR MAKING JEWELRY IN THIS BOOK

Acids: nitric, 1 lb.

sulphuric, 1 lb.

Annealing pan with lumps of pumice—needed only if blowtorch is used

Anvil (page 19, Figure 12)

Asbestos block, 4″ x 5″ or larger (page 8, Figure 9)

Asphaltum, ½ lb.

Bench pin (page 8, Figure 15 and page 30, Figure 11)

Bench vise, 3″ jaw (page 8, Figure 13 and page 77, Figure 3)

Benzine (or benzole or turpentine), 1 qt.

Binding wire, iron, 1 lb. each of 14, 16, 18, 22 gauge (page 9, Figure 19)

Blowpipe, blowtorch, or Bunsen burner

Where city gas is available

Blowpipe, small, for chain work (page 8, Figure 5 and page 88, Figure 1) or

Bunsen burner (page 8, Figure 4 and page 56, Figure 5)

Both can be attached to kitchen range with extra long rubber tube, about 3′

Blowtorch, desirable, but not essential except for enameling. 11″ long, air tube 3/32, gas tube 9/32, used with compressor or bellows (page 17, Figure 1)

Where city gas is not available

Blowpipe with alcohol flame or

Tank or bottled gas with specially designed attachments

Bottles, acid, 3 with glass stoppers

Brushes, camel's hair #2 and #5

Brushes, small for flux (page 8, Figure 3)

Burnisher, curved (page 9, Figure 33 and page 58, Figure 13)

Carborundum stones

Center punch (page 29, Figures 4 and 6)

Charcoal blocks, 6 (page 8, Figure 10)

Clamps, "C," 4″

Dapping die

Dapping tools (page 9, Figure 36 and page 13, Figure 2)

Dividers, 5″

Drawplate, medium, round (page 9, Figure 23 and page 75, Figure 1)

Drill, hand (page 9, Figure 21 and page 29, Figure 7)

Engraving tools

Files: one set of needle files, assorted shapes (page 8, Figure 16)

one set of riffle files

half-round, double-cut medium, about 8″ (page 8, Figure 7)

flat, double-cut, coarse and medium, about 8″

Flux: borax stick and borax slate (page 8, Figures 1 and 2)

prepared liquid or paste

soft solder, paste

Graduate, 16 oz., glass (page 22, Figure 5)

Gravers: 1 square-end 3/32″ (page 66, Figure 5)

1 half-round (page 66, Figure 5)

Hammers: carpenter's

chasing (page 8, Figure 6)

planishing

ball pein, or machinist's, 14 oz. (page 19, Figure 12)

riveting (page 75, Figure 4)

Hardwood block, 6″ x 2″, solid maple (page 21, Figure 3)

Japan drier, 3 oz.

Lead block, 4″ x 4″ x 1″ (page 73, Figure 19)

Liver of sulphur (potassium sulphide), 1 lb.

Mallet, rawhide, medium (page 8, Figure 11)

Mandrels: 1 bracelet (page 23, Figure 6)

1 ring (page 9, Figure 31 and page 55, Figure 3)

Metal snips, or shears (page 8, Figure 8 and page 21, Figure 2)

Nail set

Nippers, side-cutting (page 9, Figure 24)

Ochre, powdered, ¼ lb.

Oil stone, India, combined medium and fine (for sharpening scraper and scriber)

Pickle jar (glass refrigerator jar with lid is ideal)

Pickle pan, copper

Pitch bowl with pitch (page 48, Figure 5 and page 49, Figure 6)

Plaster of Paris, 1 lb.

Pliers: chain (page 9, Figure 27)

flat-nose (page 9, Figure 25)

round-nose (page 9, Figure 26)

Pumice, powdered, 1 lb.

Pusher (page 9, Figure 34 and page 58, Figure 11)

Pyrex dish, or small white enameled pan

Repoussé tools (page 48, Figure 4)

Resist varnish, a commercial preparation, or one made of asphaltum and benzine

Ring clamp (page 8, Figure 17)

Ring gauge (page 8, Figure 14)

Ring pad, 6″ (page 48, Figure 5 and page 49, Figure 6)

Saw blades, #2/0 and #1/0, 2 doz. of each (page 8, Figure 18)

Saw frame (page 8, Figure 18 and page 30, Figure 11)

Scotch stones, 3, ⅜″ square

Scraper, hollow triangular, 2″ blade (page 9, Figure 32)

Scriber (page 9, Figure 30)

Solder, silver; hard, medium, easy-flowing

lead; soft

Stamping tools (page 46, Figure 5)

Steel block, polished, 4″ x 4″ x 1″ (page 8, Figure 12)

Steel wool, fine

Tongs: 20″ long

copper for pickling

draw (page 9, Figure 22 and page 75, Figure 1)

Trays, developing, hard rubber or Pyrex, 8″ x 10″, 2 (page 22, Figure 4)

Tweezers: 5″ (page 9, Figure 29)

soldering (page 9, Figure 28)

Tripod for Bunsen burner (page 62, Figure 4)

Twist drills, #50, about 6 (page 9, Figure 20)

Wire gauge (page 9, Figure 35)

Wire mesh screen, for tripod of Bunsen burner, 6″ x 6″ (page 62, Figure 4)

Work bench or table, but an ordinary kitchen table will do with a bench pin attached (page 94, Figures 1 and 2)

HAND POLISHING EQUIPMENT
if you have no motor

Chamois skin, 8″ x 8″

Emery cloth, 6 sheets #3/0

Emery paper (finishing paper), 6 sheets #3/0

Hand buffs: 1 felt, 1 chamois (page 58, Figure 14)

Rouge stick

MOTOR-DRIVEN POLISHING EQUIPMENT

Flannel wheel

Felt wheel: 1 hard, 3″ x ½″ face

1 soft, 3″ x ½″ face

Inside ring buff

Lathe splasher, 52″ wide, 9″ deep

Motor, electric, ⅛ H.P. (page 93, Figure 8)

Muslin wheel (page 93, Figure 8)

Rouge stick

Tripoli stick

ENAMELING

Enamels, transparent: red, yellow, blue, green, colorless (flux), black, 1 oz. of each

Enamels, opaque: red, yellow, blue, green, white, black, 1 oz. of each

Furnace, kiln, blowtorch, or Bunsen burner

Mortar and pestle (page 62, Figure 5)

Spatula (handmade of heavy copper or brass wire)

MATERIALS FOR MAKING JEWELRY IN THIS BOOK

Copper, sheet and wire (order by gauge, same as silver)

Findings:

Catches, plain and safety; sterling or German silver; for hard and soft solder

Ear wires, sterling silver, for soft solder

Joints, sterling or German silver; for hard and soft solder

Pin backs, metal

Lead, sheet and wire (order by gauge, same as silver)

Silver, sheet and wire—for ordering see page 6

Stones—order from firms on page 7 according to requirements of project

Wire: lead

brass

brass rivet

copper

silver

PROJECT I: SIMPLE REPOUSSÉ

Pins and Buttons in Thin Gauge Metal

Materials: **a piece of 34 gauge sheet silver or copper 2″ square, a disc 2½″ in diameter, or any other shape you wish of similar size; a 1¼″ metal pin back; for buttons allow enough metal for the size and number of buttons needed, and about 12″ of 24 gauge wire for the loops**

Tools and Supplies: **two steel styluses or dapping tools, with rounded ends ⅛″ and ¼″ in diameter; kitchen knife; camel's hair brush; hand buff; small amount of plaster of Paris; waterproof cement; rouge; pumice; liver of sulphur; Pyrex dish; cloth; two small blotters or pad of newspapers about 2″ x 2″**

Simple repoussé is one of the easiest jewelry processes possible and a good one for the beginner because it will not only give him a feeling for metal, but will also insure quick results and almost certain success. In spite of its simplicity, however, it allows a wide variety of designs and applications. The project can be done with a minimum of tools and physical energy, and therefore is ideal for work in occupational therapy.

Repoussé is a French word meaning "thrust back." The type described here is a variation of true repoussé (see Project X). The metal used is so thin that the usual repoussé tools and hammer are not necessary to work it. It is so easily and quickly worked that some craftsmen use it to try out designs for true repoussé.

The design is made on metal from the back side by pushing or rubbing with a tool. When turned over the design appears raised or embossed (Figure 1). The metal used is so thin that almost any tool with a smooth end will work. Two tools are needed, one with a rounded end of ⅛″ for use as a liner, ond one with a rounded end of ¼″ for embossing areas. Dapping tools, ⅛″ and ¼″, are excellent (Figure 2).

You can make your own styluses with half-round ends (Figure 3), from ⅛″ and ¼″ round steel or a heavy nail or spike. Round the ends to a half-ball with a medium double-cut file and smooth them with #3/0 emery cloth and #3/0 emery paper. A grip may be added by wrapping the shank of the tool with several windings of electrical tape or gummed paper tape. If these tools

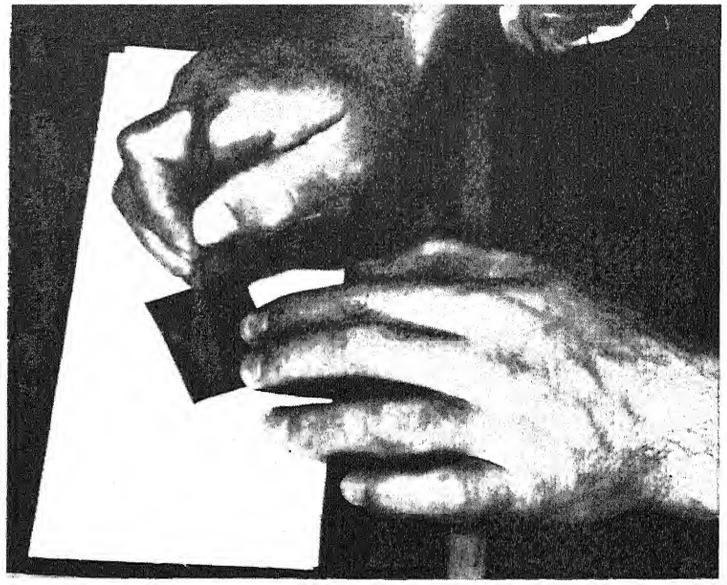


Figure 2

are not available, a pencil or orange stick will do as a liner, and a blunt-end tool like the smooth metal top of a mechanical pencil will do for the areas. Hold the tool vertically and rub back and forth with hard, firm pressure.

DESIGN The design may be an arrangement of simple lines and geometric shapes (Figure 1) or stylized animal forms (Project X, Figures 3 and 8).

It may be practical to start with geometric line arrangements. You can first try your designs with pencil and paper. Draw a shape: square, oblong, circle, or oval, then fill the area with line designs in a symmetrical (Figures 1 and 4) or asymmetrical balance (Figure 5). Draw freehand without the use of instruments.

You will get a better idea of the effect of the design if you go over the lines with ink, using a small brush or a lettering pen which makes a 1/16″ line, or a line equal to the width of the raised line desired. Better still, you can make your designs spontaneously on the paper with brush and ink, or work directly on metal with the tools, making up the design as you go along. As the metal is inexpensive, and easy to work, it will not matter if you spoil a few pieces in the interest of learning.

PROCEDURE To start the repoussé, lay two blotters, one on top of the other, on a hard, smooth surface such as a table top or a sheet of heavy metal (Figure 2). A pad of ten sheets of newspaper may be used instead of the blotters. Place the metal to be decorated face down

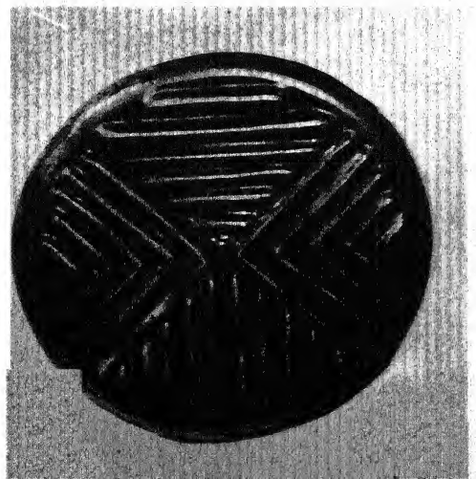


Figure 1

Figure 3

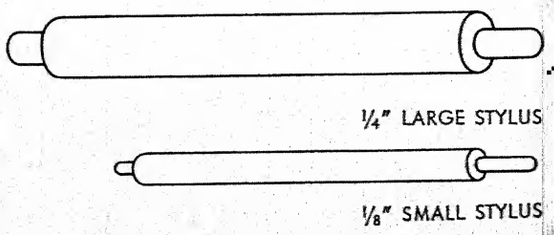


Figure 4

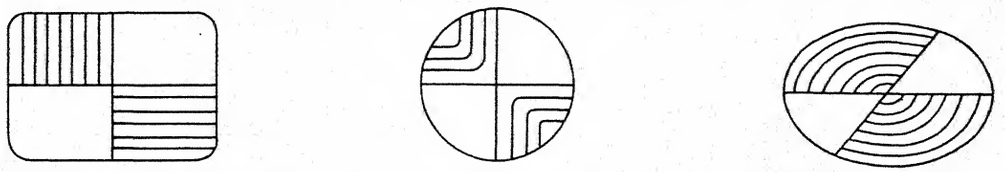
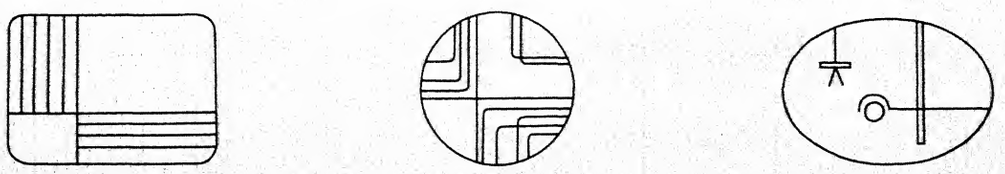


Figure 5



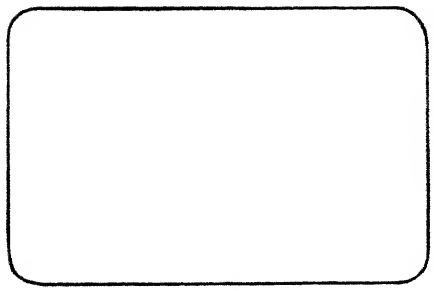


Figure 6

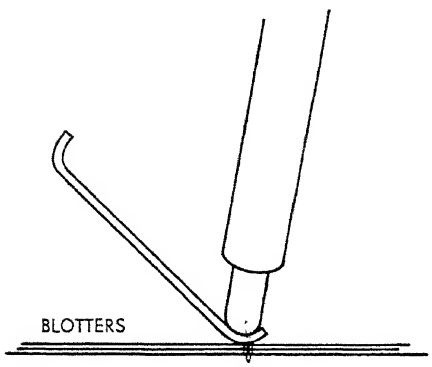


Figure 7A

Figure 7B

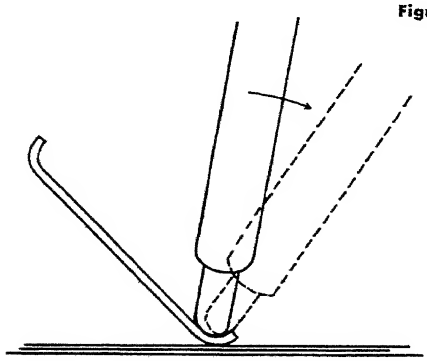
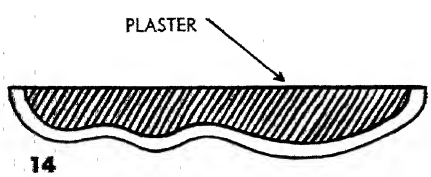


Figure 8



on the blotters. With the liner, ⅛" tool, press and rub back and forth on the line until the desired depth has been reached, move to the next line, and so on until the decoration is finished. Check for depth and smoothness by turning the piece over occasionally to examine the face side. If a name or initial is used it must be traced in reverse on the back or it will come out backwards in the finished work.

After you have completed a simple piece in line design you can plan one with both lines and areas which may be made up of geometric, stylized natural, or free invented forms. Make the repoussé lines as described above. To make raised areas, first outline each area with the liner and then rub the whole area with the large stylus or dapping tool.

It now remains to turn down the edges of the piece. This adds to the appearance and makes it stiffer. Trim the edges with metal snips or ordinary scissors, allowing a little more than ⅛" extra all around for turning the edges. If the piece is rectangular the corners should be rounded (Figure 6). To turn the edges hold the piece on the blotters as shown (Figure 7A). Use the large stylus. The corners will be most difficult to turn because the metal has to be crowded, that is compressed into a smaller space than that which it occupies in the flat state. Wrinkles will develop at the corners. To remove them lower the angle of the tool and continue to rub hard (Figure 7B). When the edges are turned the piece is ready for the backing and the pin back or loops.

Because the metal is so thin it is necessary to support it to prevent crushing during ordinary use. This support should be of a material which will fill the raised parts. Plaster of Paris is excellent for the purpose. To mix, put two tablespoons of water in a saucer and sprinkle a slightly

larger amount of plaster onto it until it is the consistency of thick cream.

Lay the piece face down or hold it in your hand, and fill it to the brim (Figure 8). Scrape off the excess with a kitchen knife. While the substance is still soft, press the pin back into it and spread the plaster over it, being careful not to cover any of the working parts. Use a pin back with holes for a better hold. Another way of setting the pin back is to cut a depression for it while the plaster is semi-soft, and after it is thoroughly dry cement the pin back with waterproof cement (Figure 9). Be sure to place the pin back a little above center or the pin will tend to fall forward when it is being worn. If there are high parts when it is dry, sandpaper them off. The turned edge should hold the backing in place, but if it comes out, paint it with cement and replace.

Clean the surface with pumice on a wet rag before oxidizing it (see page 91.) To oxidize, put a small lump of liver of sulphur about the size of a hazelnut in a Pyrex dish and add about a cup of water and heat, do not boil. Paint the solution on with a soft camel's hair brush. This will turn the surface black. Try not to get it on the back as it will soil the plaster. Save the solution in a closed jar for further use. Now rub the surface with a wet cloth and a little pumice (household cleanser will do) to brighten the raised areas, keeping the cloth flat so as not to clean the oxidation out of the lines and low areas. Wash off the surface with water and polish it with a hand buff and rouge (see pages 92 and 93). Put a little rouge on the buff and rub it gently in a backward and forward motion over the pin.

Decorative buttons may also be made by this method of repoussé. The loops of the buttons can be made of wire which is embedded in the backing substance while it is still soft (Figure 10).

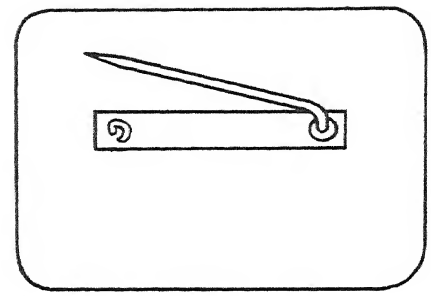


Figure 9

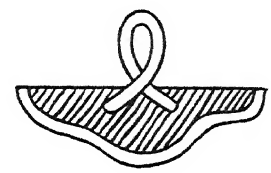


Figure 10

Figure 11 Chinese metal jar with repoussé decoration. Photo from American Museum of Natural History, New York.

PROJECT II: WIRE PINS

and Hair Ornaments or Lapel Pins

Materials: 12 or 14 gauge round copper, brass, nickel silver, or sterling silver wire, about 20″ long

Tools and Supplies: side-cutting nippers; chain or flat-nose pliers; blowpipe or blowtorch; ball pein hammer; planishing hammer; steel block; set of needle files; charcoal block; asbestos block; #3/0 emery cloth; #3/0 emery paper; steel wool

In this project the beginner will learn the feel of wire, its limitations and possibilities, by working directly with metal instead of first drawing the design on paper. Cut a piece of 14 gauge wire 18″ or 20″ long with the side-cutting nippers. Coil it in a loop about 2″ in diameter and lay on a charcoal block. Be sure the charcoal block is on an asbestos block. Heat the wire with a blowpipe or blowtorch (Figure 1) until it is a dull red to soften the metal so that it can be worked easily. This is called annealing. Cool by dipping in water.

Begin the pin by bending the wire with the pliers to form a catch (Figure 2). The opening of the catch should point down (Figure 3). Next create a design by bending the wire in any one of the following ways: regular loops, or loops graduating from small to large (Figure 4); regular or graduating scrolls; angular bands in units of regular size, such as triangles (Figure 5), rectangles, or squares, or alternate small and large units. Let the metal dictate the design by follow-

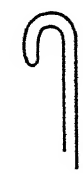


Figure 3

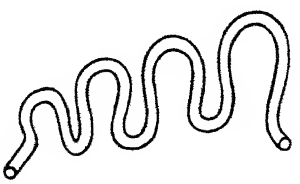


Figure 4

Figure 5

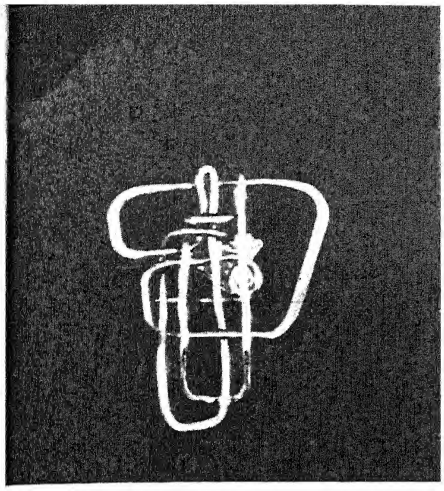


Figure 6 Pin made by a veteran.

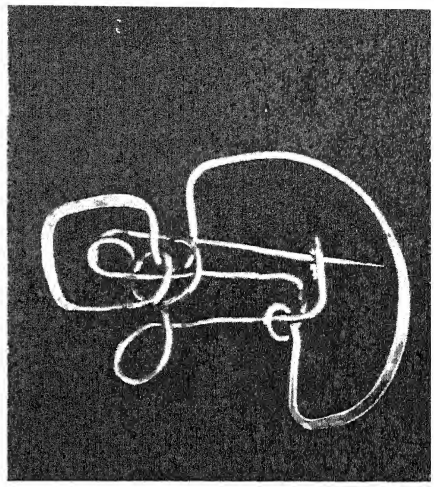


Figure 7 Pin made by a veteran.

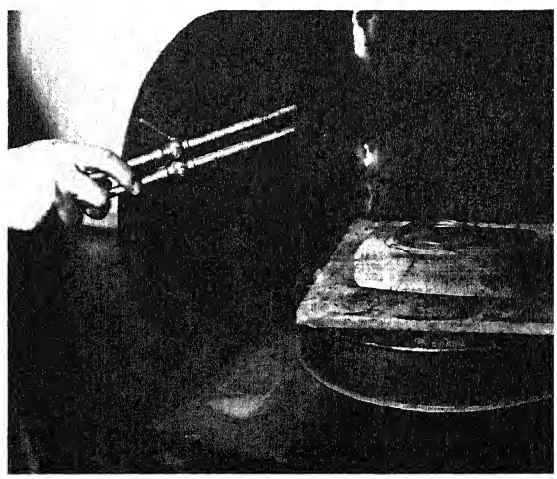


Figure 1 Heat the wire with a blowpipe or blowtorch.

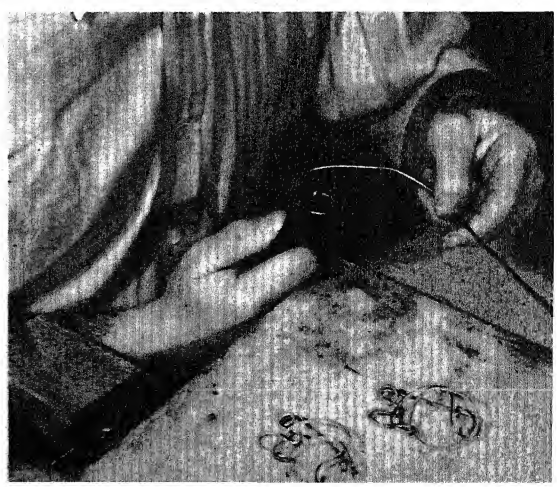


Figure 2 Begin by bending wire to form a catch.

ing any rhythm that it suggests. Good construction may demand the passing of one wire over another, or passing one wire completely around another (Figure 8). This will add strength to the pin as well as give it a more interesting appearance. Shape a single loop at the end of the wire, which corresponds to the joint of an ordinary safety pin (Figure 9). This is done to give spring to the pin. Leave the pin tong projecting for the next operation (Figure 10).

Harden the pin tong by hammering lightly with the ball pein hammer on a steel block. File away hammer marks on the pin tong and let the end extend about ⅛" beyond the catch, filing it to a sharp point. Place the pin tong above the center of the ornament or it will fall forward when it is being worn. Finish the pin tong and its point by rubbing on #3/0 emery cloth and #3/0 emery paper or fine steel wool. Bend the pin tong to its proper position so that it will engage the catch (Figure 11).

The appearance of the pin may be improved by flattening the wire somewhat in some sections of the design. This is done by hammering the wire where accessible with a steel planishing hammer on the steel block or on a slightly domed (rounded) anvil, but care should be taken not to flatten wires that overlap as they tend to cut each other and break (Figures 12 and 13A and B).

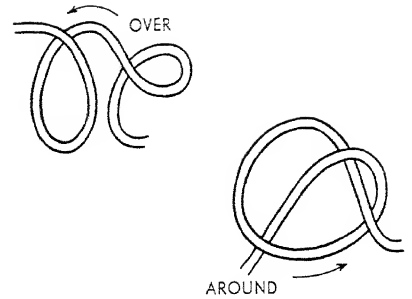


Figure 8

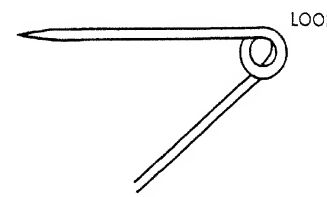


Figure 9

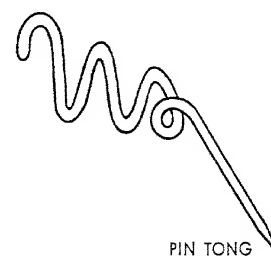


Figure 10

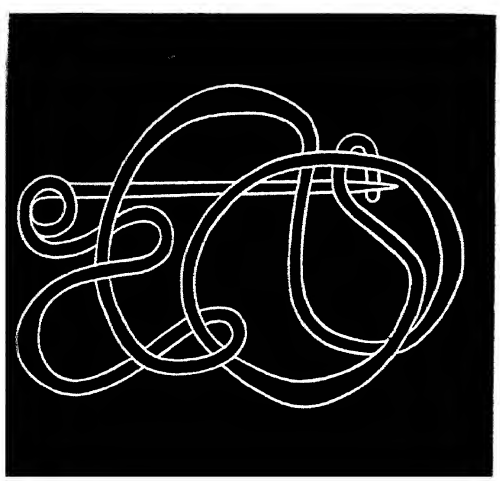


Figure 11 Bend pin tong so that it will engage the catch.

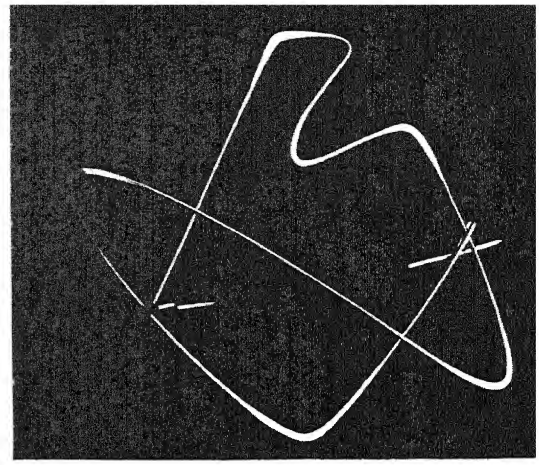


Figure 13A Pin by Claire Falkenstein. Photo by Hi Hirsh.

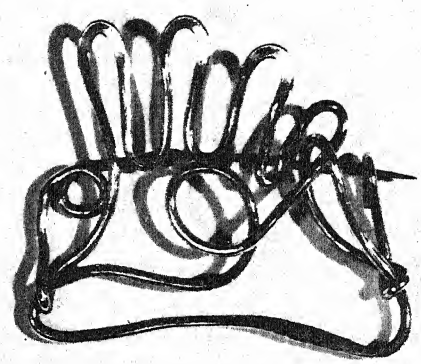


Figure 13B Finished pin with some wires flattened.

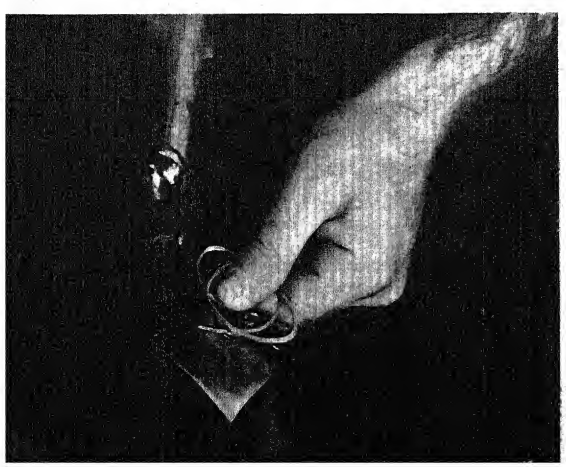


Figure 12 Hammer the wire where accessible with steel planishing hammer on steel block or anvil.

PROJECT III: ETCHED DESIGN

Open Bracelet

Materials: 16 gauge sheet silver or copper, 6″ x 1″

Tools and Supplies: metal shears; rawhide mallet; hardwood block; camel's hair brushes, no. 2 or 1/16″ stroke, no. 5 or ¼″ stroke; bracelet mandrel; bench vise; files; carbon paper; blotter; soft string; cloth; 2 glass or hard rubber developing trays; 16 oz. mixing graduate; pumice; #3/0 emery cloth; #3/0 emery paper; resist varnish; nitric acid; benzine (or turpentine)

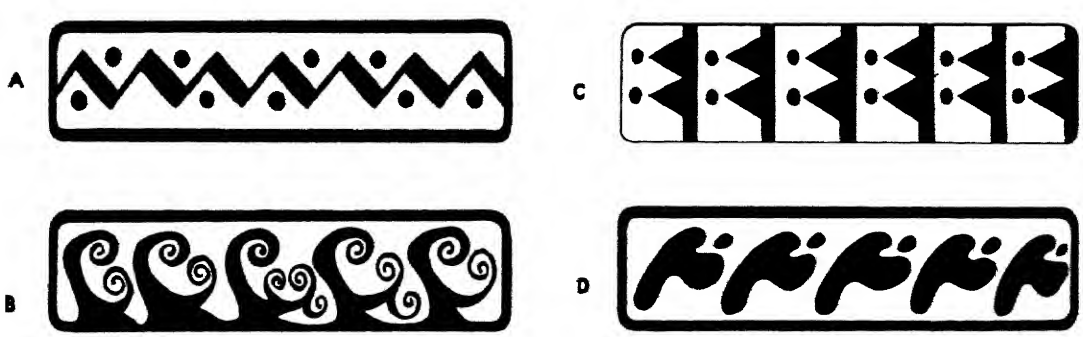
Tools and Supplies for Hand Polishing in addition to those above (see page 92)

Etching on metal is done by painting with a resist varnish and etching the piece in acid. The parts covered with varnish remain in relief while the parts that are exposed are etched lower than the surface, depending on how long the piece remains in the acid.

DESIGN Since the design is painted on the surface, it is advisable to use flowing lines or large masses, avoiding sharp corners and straight edges (Figure 7). Free geometric designs similar to those seen in the decorations of primitive peoples are quite possible and attractive in etched patterns (Figure 1 A-C). Organic or stylized natural shapes also lend themselves to decorative treatment (Figure 1D).

Plan your design on paper first. Mark out several rectangles, 1″ x 6″, with a ruler, or by tracing around the piece of metal out of which you are going to make the bracelet. Try a different design in each with brush and ink (Figure 1 A-D), blacking in the parts to be left in relief. This is done to give an approximate effect of the finished piece. Avoid stripes of less than 1/16″ which are to be covered by the varnish. If the etching is to be deep, plan the design so that no part of the outer edge of the piece of metal will be eaten as it will weaken the bracelet. It may be advisable to leave a border on your etched pieces until you have gained some mastery over the process. When you have a design you like, draw it up carefully and prepare the metal plate.

Figure 1



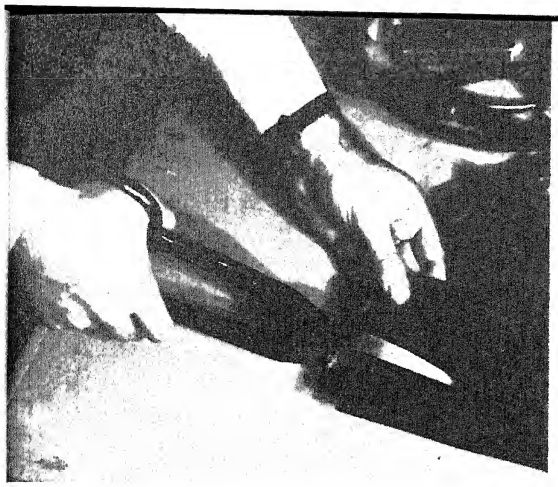


Figure 2

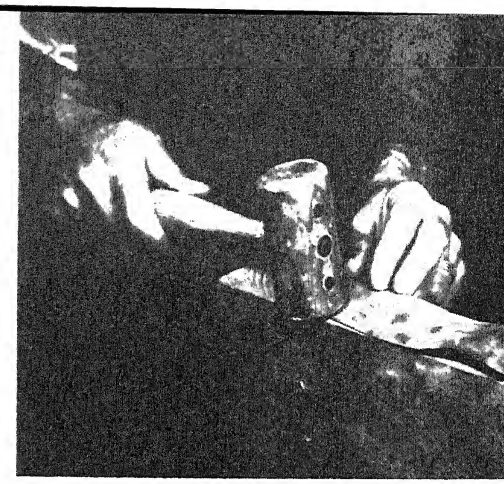


Figure 3

PROCEDURE Cut a piece of 16 gauge sheet copper or silver 1" x 6", with the metal shears (Figure 2). Flatten all sheet metal with a rawhide mallet on a hardwood block if it is uneven (Figure 3). Clean the back, edges, and face of the metal by rubbing lengthwise with a wet cloth dipped in pumice powder. This is done so that the varnish will adhere well. Test for cleanliness by dipping the metal in water. If it is clean, it will hold a film of water throughout its whole area. If the metal is not clean, the resist may lift off during the etch. Cleaning with pumice removes the polish from the surface of the metal, but makes for better adherence of the varnish. The polish can be restored after the etch.

Transfer the design from paper to the metal with carbon paper, being careful not to allow the fingers to touch any part of the metal. Lay the carbon paper face down on the metal and the design face up on the carbon paper. Trace the design with a pencil, using a medium heavy pressure. With a small camel's hair brush, No. 2, or about 1/16" stroke, paint the design in varnish, only in the areas which show black in the original design. In other words, paint in the parts which are not to be etched. The edges of the bracelet should be painted at this time.

The back must be covered also, but in order to do this, the parts already painted must be allowed to dry for about three or four hours, or perhaps it is better to let it stay overnight and begin another piece or project in the meantime. Use a No. 5 brush, or about ¼" stroke, for the back and large areas. Apply a medium-thick coat of varnish. Too thick a coat takes longer to dry and is of no advantage. Allow the same amount of time for the back to dry.

The resist varnish commonly used by craftsmen, and sold by dealers in jeweler's supplies, is a composition of asphaltum dissolved in benzine. A varnish may be made with turpentine, but it takes longer to dry. The common fault of most resist varnishes is that they tend to lift or crack, especially when the acid is strong. The ordinary asphaltum (benzine composition) may be improved by adding 1 oz. of benzole and ½ oz. of Japan drier to 4 oz. of varnish.

To make improved resist varnish, purchase lump asphaltum, benzine (or benzole), and Japan drier. Crush 1 oz. of asphaltum to a powder and put it into a wide-mouth jar. Add 1 oz. benzine (or benzole) and ½ oz. drier a little at a time. Stir until it is the consistency of light cream. Keep tightly covered when not in use. The following resist varnishes may be experimented with: Colorite (straw hat dye), stove pipe enamel, and fingernail polish (dark colors).

The piece is now ready for etching. Place two developing trays on a bench or table (Figure 4).

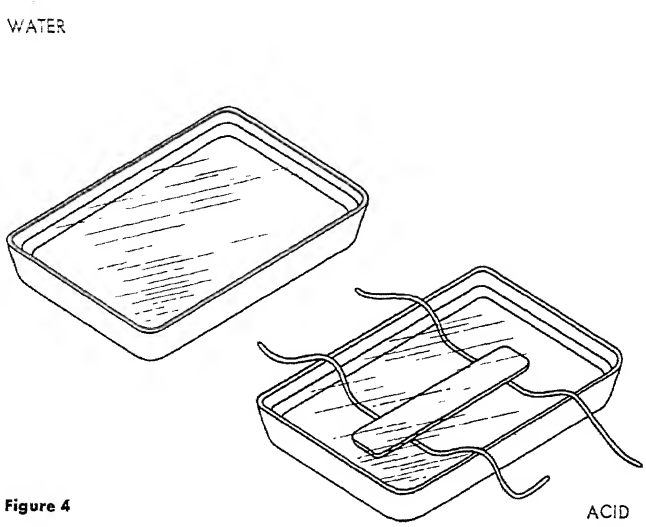


Figure 4

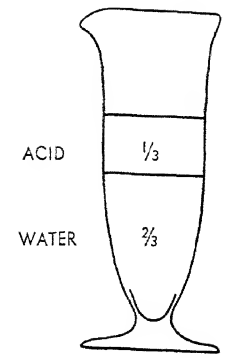


Figure 5

One tray is for water and one for dilute nitric acid. Mix the acid and water in the glass graduate in the proportion of one part acid to two parts water (Figure 5). If a slower etch is desired, use a one to three solution. It is better to use a weak acid. It takes longer to etch, but it makes a cleaner line and has less tendency to break through the varnish. ALWAYS POUR THE ACID SLOWLY INTO THE WATER. The reaction of the acid and water generates heat and thus raises the temperature of the solution. Pour the solution into one of the trays and allow to stand for about fifteen minutes, or until it returns to room temperature. If used while warm, the action on the metal is so rapid that the solution becomes still hotter. This may result in the softening and lifting of the varnish resist.

Half-fill the other tray with water and when the acid is ready, slip two pieces of soft string under the metal piece. The strings serve as lifters during the etching operation and are kept in their original positions under the piece during the total etching time (Figure 4). Put the bracelet in the acid, and after a few seconds examine it to note the speed of the etch. If the solution is etching properly, the etched areas will be covered with many tiny gas bubbles, which break after a second or two and are replaced by others. This is an indication that the solution is working or that the metal is being eaten away.

During the etch the worker has a choice of two procedures. If a pebbly effect at the bottom of the etched area is desired, it is obtained by leaving the piece and the tray undisturbed throughout the etch. The pebbly effect which results is caused by the gas bubbles preventing the uniform flow of the acid over the area. If a smoother etch is desired, the bubbles must be broken frequently. This may be done either by lifting the piece out of the acid, using the strings, or by tilting the tray in such a way as to expose the etched areas to the air for a second or two. The aim is to break the gas bubbles.

CAUTION: DO NOT INHALE THE FUMES FROM THE ETCH OR SPILL ACID ON YOUR HANDS OR CLOTHES. If you chance to get acid on your hands, wash them at once with soap and plenty of running water. If you get it on your clothes, apply a solution of household ammonia (two tablespoonsful to a glass of water) generously.

Whichever procedure is followed, whether leaving the bubbles or breaking them, it is important to examine the varnish resist frequently in order to guard against breaks or pinholes. The back

also should be examined, but less frequently. Whenever the piece is removed from the acid it should be placed in the water tray. If repairs to the varnish are necessary, remove the piece from the acid, pass through water tray, dry carefully with a blotter and allow to stand for ten or fifteen minutes. This is to insure that no dampness or moisture remains in the cracks or pinholes before patching the varnish. Use a small brush in patching with the varnish, and put the piece aside to dry for several hours. When the varnish is dry proceed as before with the etching.

The depth of the etch is the choice of the designer, although in the interest of the strength of the piece, it is advisable not to etch deeper than one-third the thickness of the metal. Deep etches are best done with a slow or weak acid over a long period of time. The etch may take several hours. When the desired depth is obtained, remove all varnish by immersing the piece in a saucer of benzine (or turpentine), or rubbing with a cloth dipped in benzine (or turpentine), or by combining both methods. Wash in soap and hot water.

Now form the bracelet over the bracelet mandrel using a rawhide mallet. Fasten the bracelet mandrel in the bench vise. Begin the bending of the bracelet by hammering the ends first (Figure 6). Smooth edges with #3/0 emery cloth and #3/0 emery paper. This operation may precede the shaping of the bracelet. Leave bright or oxidize in liver of sulphur. Oxidizing gives a black coating to the silver which is rubbed off on the high parts with a wet cloth dipped in pumice, to emphasize the modeling and give contrast to the metal (see page 91). Polish with rouge using a hand buff (see pages 92 and 93).

Now that you have learned to etch a bracelet you can etch other kinds of jewelry, such as pins, rings, clips, or earrings. You can also combine etching with other techniques—piercing, appliquéing, repoussé or enameling as you learn to do them. These projects give you merely the basic processes; the variation and application of their use must be left to the ingenuity of each

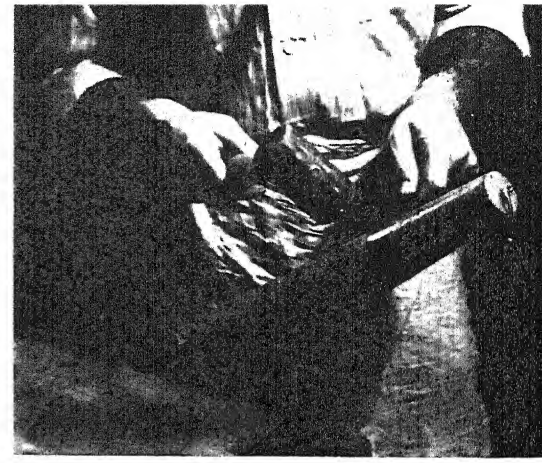
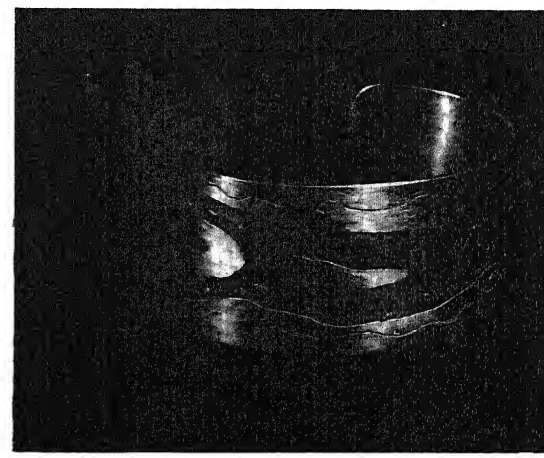


Figure 6

Figure 7 (below) **Finished bracelet**

Figure 8 (bottom) **Etched bracelet by Charles J. Martin.**



PROJECT IV: WIRE BRACELETS

and Other Jewelry Made of Wire

Materials: one or more pieces of 10 or 12 gauge round, square, or flat wire in silver, copper, nickel silver, or brass depending on the design chosen, each piece about 10″ long (read the project through first, then decide on material); 10 or 12 gauge round lead or soft brass wire, about 24″ long

Tools and Supplies: blowpipe; polished steel hammer with slightly domed face (planishing or machinist's hammer); rawhide mallet; hand drill; jeweler's saw; needle files; slightly domed steel anvil; bench vise; bracelet mandrel; tweezers; pliers, copper tongs; flux brush; motor buff with muslin wheel; charcoal block; asbestos block; 16 gauge binding wire; dish of water; pickle pan; stiff brush; cloth; #3/0 emery cloth; hard silver solder; flux; pumice; rouge; pickle

Tools and Supplies for Oxidizing in addition to those above (see page 91)

DESIGN The aim of this project is to learn the decorative possibilities of constructing with wire through designing a bracelet by flattening, waving or twisting a single wire and shaping it into a bracelet, or combining several wires, soldering them and shaping them into an open or closed bracelet (Figures 1 and 2). The design of the bracelet may first be tried out in lead or soft brass wire. These are easier to manipulate and therefore the design not only can be more quickly worked out, but changes are easily made. When a suitable design is achieved it can be duplicated in any one of the harder and more permanent metals suggested above. Whether you plan to try your design out in the softer metals or work directly with the harder ones, proceed as follows.

PROCEDURE The closed bracelet should be about 8″ long before bending. For the open type, 6½″ or 7″ is commonly used. However, it is advisable to measure the wrist to secure the appropriate size. Add a half-inch for the open type. In measuring for the closed type be sure that you allow enough to enable the bracelet to slip over the hand easily. If you make it too long you may find that you will spoil the design when cutting it to the right size.

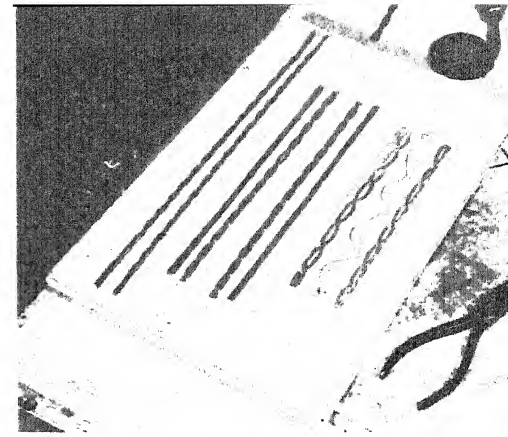
If a combination of silver and other metals is used, plan an effective relationship; for example, have the silver strips or wires on the outside with copper or other metals forming the inside band. The reason for placing the silver wires on the outside of the bracelet is that silver does not discolor the skin as does copper or brass. If some copper wires do touch the skin, they may be lacquered with either metal lacquer or colorless nail polish.

For variety, combine plain round with flat and twisted wires. Metal must always be annealed before it is worked (see page 88). Keeping in mind that the length of the wire or wires is reduced in twisting, cut pieces about 1″ longer than the desired finished length, that is about 9″ or more for a single twist. For a double twist, take an 18″ length and bend it in the middle to form a double, parallel strand. Fasten the

loose ends in a bench vise, being careful to avoid kinks and to keep the two wires the same length, and the loop end in the chuck of a hand drill. Turn the drill to form the twist, pulling lightly toward you as you turn (Figure 3). Twisting to the left or right produces a different effect. Both may be used in the same bracelet for variety.

To twist a single wire it must first be flattened unless you have purchased a flat or square wire (Figure 1 H). Flattening is done by hammering a round wire with the steel hammer on the steel anvil. Try to keep it as smooth as possible and of uniform width and thickness. Follow the procedure described above for a double twist to twist square, or flattened single wires. The tightness of the twist should be determined beforehand according to the effect desired. An interesting open effect can be produced by giving the wires less twist and then flattening them by hammering (Figures 4 A, B, E, F). A variety of wires can be made by using different twists and different sizes or shapes of wire. Other interesting designs can be made by winding wire around dowels or nails (Figures 5 D and E).

When the different wires are made, the next step is to solder them together. In simple two or three-wire designs, this may be done in one operation, but if the design is complex, do not attempt to solder all the parts together at once. Straighten all wires and keep them in the flat



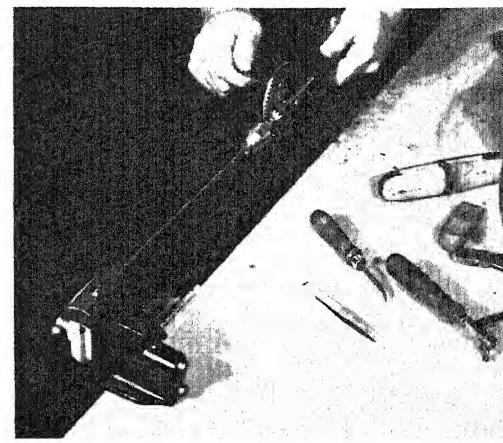


Figure 2 (above) **Wires prepared for a bracelet.**

Figure 3 (below) **Making a double twist.**

Figure 1

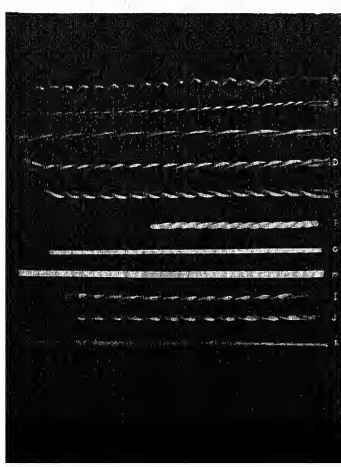


Figure 4

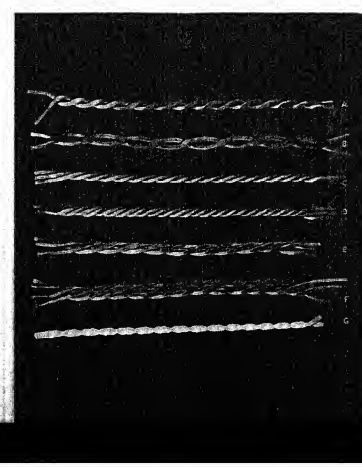
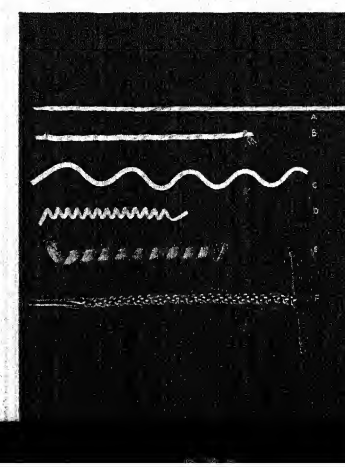


Figure 5



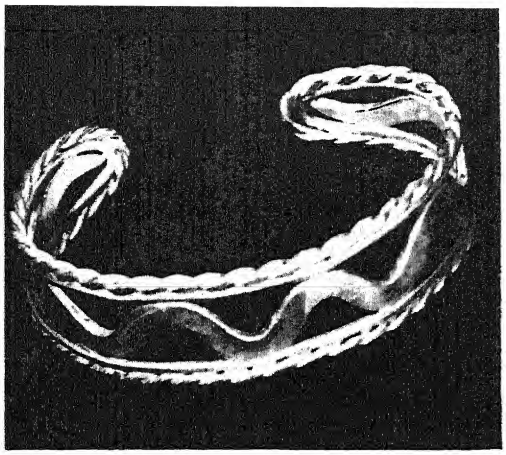


Figure 7

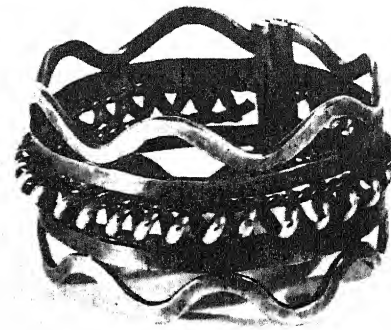


Figure 8

shape for soldering. (See Annealing, Hard Soldering, and Pickling, pages 88-91, before proceeding with the soldering here.) With a file, clean the edges of wires that are to be joined, and paint them with flux. Use a large charcoal block and pin the parts to the block with right-angle pins made from binding wire (Figure 6). To make a pin, cut a piece of 16 gauge binding wire, making the cut diagonally in order to form a point. Bend it to a right angle with the pliers.

Parts that are to be soldered must touch. Place a pellet of silver solder at each contact point. Proceed as for all hard soldering by first drying the flux slowly, then concentrating the heat for about two inches on one end. As the solder melts and flows, slowly move the flame along the piece, bringing each succeeding section up to soldering temperature until the whole length has been soldered. Next examine the piece and re-solder any joints that did not catch (see page 91).

With the jeweler's saw, cut off the rough ends (see page 30 on the use of the jeweler's saw), making the piece the desired length. Use a rawhide mallet to form the bracelet over the steel or maple mandrel, beginning the hammering at the ends (see Project III, Figure 6). In an open bracelet finish off the ends by smoothing with a file and emery cloth. To join a closed bracelet, fit the ends to form a tight joint. By filing away a fraction of an inch with a medium-sized file the twists can be made to match at the joint. Solder the joint.

Pickle the piece in a solution of sulphuric acid (15 parts water to 1 part acid) in a copper pickle pan. After pickling brush with a stiff brush under running water (see page 91). Use wet pumice powder if necessary. Clean away any extra solder and file the joint smooth.

The bracelet may now be given a preliminary polish on the motor buff. Use a soft muslin polishing wheel charged with polishing rouge. The soft wheel will penetrate deeper into the depressed surfaces of the wire design than will a hard felt wheel. If you do not have a motor buff, use the hand buff. After polishing, wash the bracelet in hot water and soap. Give it a final brushing under running water.

Bracelets of this type have a richer appearance if oxidized (see page 91). After oxidizing the bracelet remove the oxide film from the top surfaces of the wires by rubbing them with a wet cloth dipped in powdered pumice, then give a final polish to the bracelet with rouge on a motor buff or with a hand buff (see pages 92 and 93).

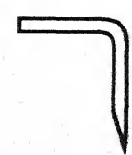


Figure 6 Right-angle pin made from binding wire.

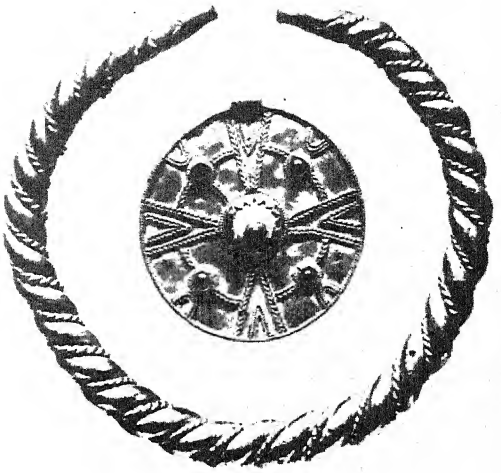


Figure 9 Anglo-Saxon and Viking jewelry from England. Photo from *A Guide to Anglo-Saxon and Foreign Teutonic Antiquities*, British Museum, London, 1923.

Figure 10 Modern Handmade Jewelry by Alexander Calder.

PROJECT V: PIERCED PIN

in Silver or Copper

Materials: **18 gauge sheet silver or copper, 2¼" x 2½" or any other simple size depending on the design chosen; catch and joint for hard solder; pin tong**

Tools and Supplies: **metal snips; jeweler's saw frame 3" or 4"; 1 doz. jeweler's saw blades #2/0; bench pin; 4" "C" clamp; 10 oz. hammer; hardwood block or steel block; scriber; center punch; scraper; needle files; large double-cut medium file; hand drill; #50 twist drill; carbon paper; blotter; glue or waterproof cement; small pieces of wood; #3/0 emery cloth; #3/0 emery paper; easy-flowing silver solder**

Tools and Supplies for Soldering, Pickling, and Polishing in addition to those above (see pages 89, 91, and 92)

"Piercing" in jewelry craft terminology, means the creating of a decorative design by sawing out shapes in a piece of sheet metal. A jeweler's saw, which is a very fine blade fastened in a frame, is used to cut out the shapes.

DESIGN A first project in piercing should be fairly simple. Narrow shapes and fine points should be avoided as should straight lines. For the beginner, curved shapes are the easiest to handle. It is therefore advisable to begin with a design which is based on an arrangement of curved or organic shapes. On a sheet of paper make several trial designs until you have one that you wish to carry out. You can make these trials by tracing around the piece of 2¼" x 2½" metal, or one of similar size, which you have prepared for your pin. You can trace around it several times to allow for a variety of designs. In the first space draw three or four curved shapes of different sizes and contours. Balance them to suit your taste (Figure 1). Make the outside shape harmonize with the inside shapes. Blacken the parts that are to be cut out.

Also, in designing, it is important to be sure that the metal which remains after the shapes are cut out is "tied" to the outer areas of the piece. Figure 2 is an example of faulty design for piercing. The dark areas represent the holes or shapes which are to be sawed out, the light areas represent the metal. Note that the only place where the inner shape attaches to the outer edge or frame is at the point X. In this design, the inner shape of metal is liable to break off at this point.

Figures 3 and 15 are examples of good pierced design. Note that the inner metal shapes are attached to the outer areas of the plates at several points. Also observe that the metal in the inner parts of the design has been considered as to shape and plays as important a part in the design as the cut-out shapes.

PROCEDURE When a suitable design has been drawn, it may be transferred to the metal by tracing the original drawing on tracing paper which is then glued to the metal sheet with glue or waterproof cement. Another method of transferring the design to the metal is by means of carbon paper (see page 21). If carbon paper is used the lines of the design on the metal should then be gone over with a scriber in order to preserve them during the sawing.

Drill a small hole in each shape to be sawed out, in order that the saw blade may be inserted. Mark the place for the drill with a center punch (Figure 4), a nail will do, placing the punch a little away from the line on the inside of the shape to be cut out (Figure 5). Lay the piece of metal, design side up, on a block of hardwood

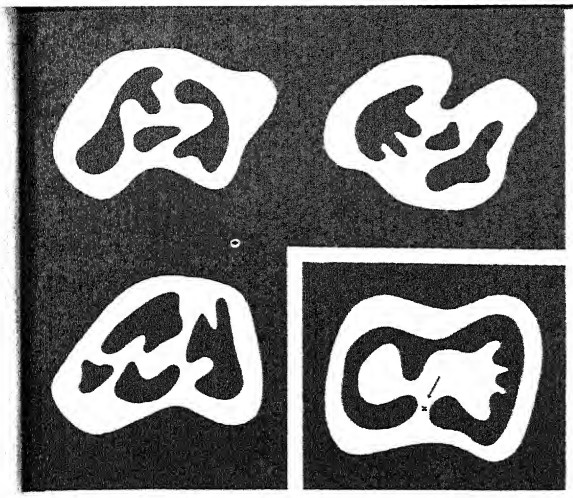


Figure 1

Figure 2

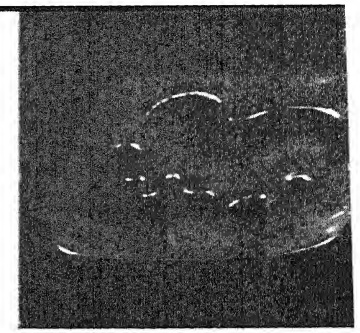
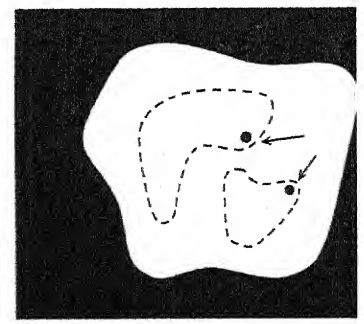


Figure 3

Figure 4

Figure 5



or a steel plate. Place the point of the punch in the right position and tap lightly with one stroke of the hammer (Figure 6).

Put the metal on a piece of scrap wood, clamping both metal and wood to the bench. To protect the metal from scratches, use a blotter or pad of paper under the clamp, or just put a nail at the edge of the wood to keep the plate from spinning. Use a hand drill and a #50 twist drill to make all necessary holes (Figure 7).

The piece is now ready to be sawed. This should be done with a jeweler's saw on a bench pin, preferably one with a "V" cut in the outer end (Figure 8). To fasten the saw blade into the frame, have the teeth pointing down, that is, toward the handle and facing out (Figure 9).

Figure 6

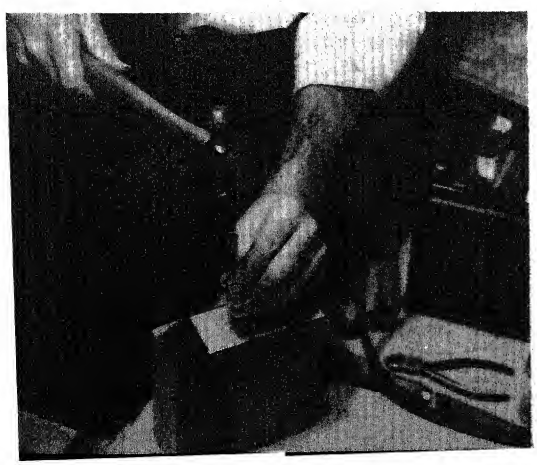


Figure 7

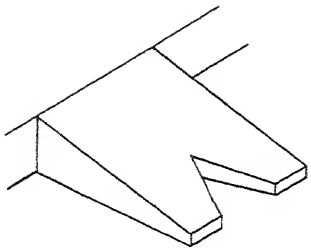


Figure 8

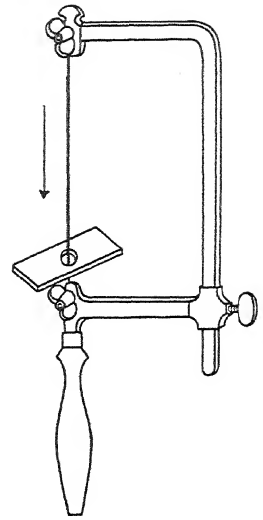


Figure 9

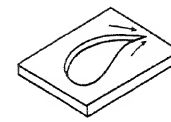


Figure 12

Figure 10 (below)

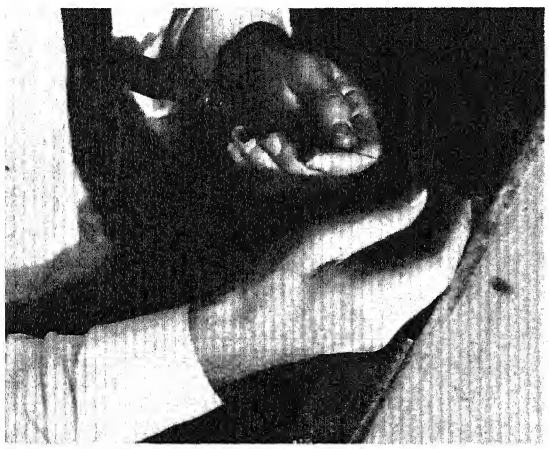
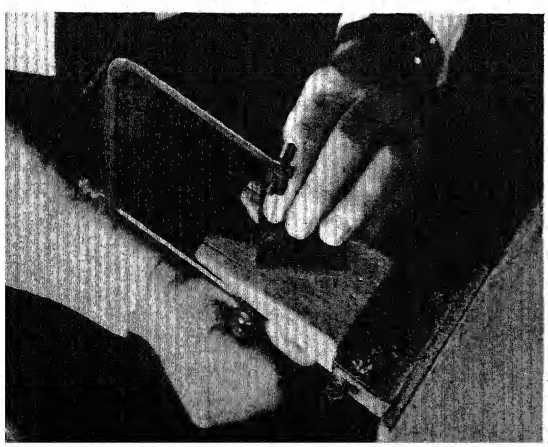


Figure 11 (bottom)



Fasten the blade in the lower clamp first, then slip the top of the blade through one of the drilled holes in the metal and allow the metal to drop onto the lower clamp. Holding the handle end of the frame against the body, place the top of the frame (where the clamp is located) against the edge of the bench. Insert the blade in the upper clamp and tighten the wing screw, while pressing the frame against the bench with the body (Figure 10). Pressing or "springing" the frame makes the saw blade tight. Test for the right tension by plucking the blade with thumb and forefinger. If the blade is at the right tension it will give off a "pinging" sound.

Now move the piece of metal, to which the saw is already attached, to the bench pin. Saw by moving the blade up and down in a vertical direction (Figure 11). Since the cutting is done on the down stroke, use only a very light forward pressure, relying on the cutting of the blade to feed the saw along the line. If possible, cut just inside the line to allow for finishing with needle files. In turning corners, keep the saw moving up and down while slowly turning the frame to point in the new direction. Do not try to turn the saw in very pointed narrow cuts. It is better to work into a sharp corner by approach-

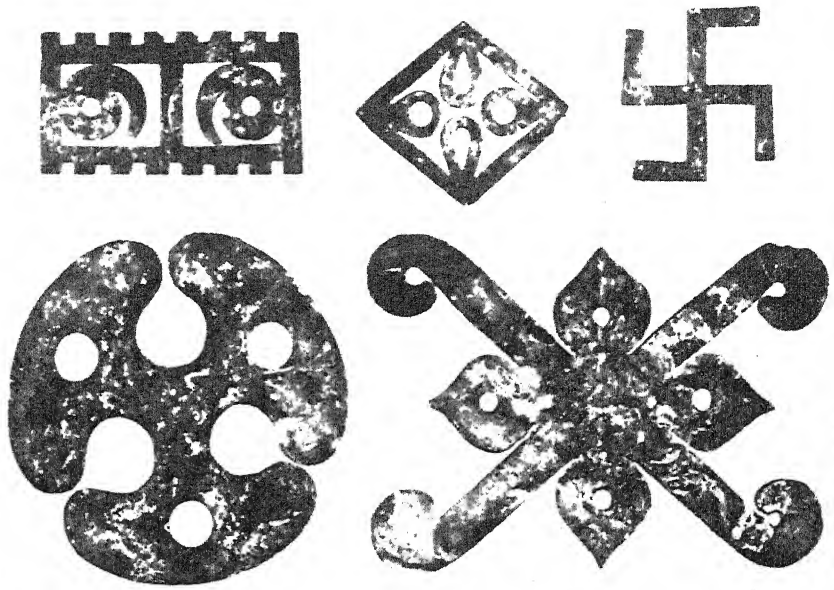


Figure 13 Copper ornaments for clothing, found at Hopewell Mounds, Ohio. Photo from *Medieval American Art*, by Pál Kelemen, Macmillan Co., 1943.

ing it from two directions (Figure 12), making two cuts toward the point. If the saw tends to stick, it may be eased by rubbing the teeth with beeswax or soap.

When all the shapes have been sawed out, use needle files of different shapes, choosing those which most nearly conform to the contours to be filed. First, file the openings at right angles to the face of the piece, then file the outer contour, using a large file where possible. Round off all edges, both on the inside cuts and on the outer edge of the piece. Use needle files, #3/0 emery cloth, and #3/0 emery paper for finishing the edges. After a pin of curved shapes has been completed, the beginner can try one of straight lines and geometric shapes which will require more accuracy in sawing (Figure 15).

Soldering the Catch and Joint The catch and the joint should be soldered to the back with easy-flowing silver solder. In ordering catches and joints from the dealer, specify hard-solder catches and joints. Also specify plain or safety catches, as preferred.

Prepare your tools for soldering and place the pin face down on the charcoal block. Place the joint at the right, the catch at the left with the

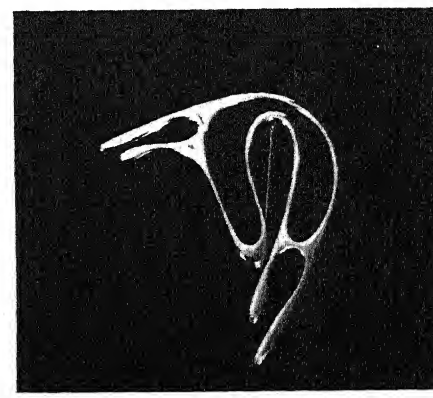


Figure 14 Pin by José de Rivera.

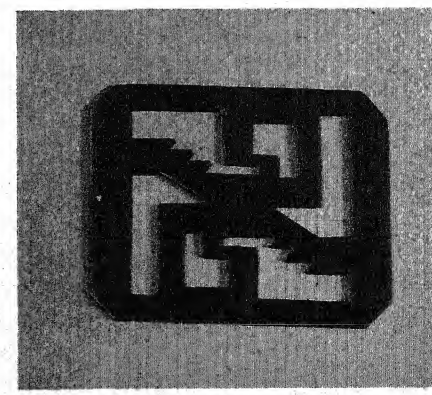


Figure 15

opening pointing down, that is, toward the bottom edge of the piece. To prevent the pin from sagging outward at the top edge when worn, place both catch and joint a little above the middle of the piece (Figure 16). The distance between the catch and joint is determined largely by the size of the pin. However, by making small adjustments in the distance between catch and joint, it may be possible to use a pin tong which is on hand without having to cut off and repoint it. Place the joint at a slight angle so that when the pin tong is riveted in it will point to the back of the catch, thus giving a slight sideways spring to the pin tong. The shoulder and rivet create a leverage and give the pin tong an upward springing action (Figure 17).

Mark the places for catch and joint and scrape these areas with a scraper, making them only slightly larger than the bases of the catch and joint. In order to make a strong juncture between the pin and the catch and joint, scrape deeply enough to get below the top scale of the metal. Clean the bases of both catch and joint by filing lightly with a flat needle file. For ordinary flat pins, it is not necessary to bind the catch and joint with binding wire. If the surfaces of both are flat, they will stand upright without support. Place one pellet of easy-flowing silver solder at the side of the base of each. Dry the flux slowly as described under Soldering, page 90, then direct the blowpipe flame to the large area of the pin. Bring the body of the pin to a dull red heat before directing the flame toward the catch and joint. If the pin is not heated first, the catch and joint, being very small in size, will heat up rapidly, with the result that the solder will run up onto one or both of them instead of onto the plate. It may even run up onto the movable safety part of the catch, in which case nothing can be done to restore the catch to its original state, and it must be replaced by another.

When the catch and joint are soldered to the pin, allow the piece to cool and pickle it. Polish it, or oxidize and then polish it if you wish (see pages 91-93).

Riveting the Pin Tong

The following additional material and tools are needed for riveting the pin tong:

Material: **brass rivet wire**

Tools: **steel block; chasing hammer; 4½" square tool steel ⅛" x ⅛"; chain pliers; #3/0 saw blades**

The final operation in making a pin is the riveting of the pin tong into the joint. This should be done after the piece has been oxidized and polished. Unless the pin tong is riveted in place, the sides of the joint will tend to spread with time, allowing the pin tong to work loose.

There are two types of pin tongs commonly supplied by dealers. The type illustrated in Figure 18 has the rivet firmly fastened in the shank of the pin tong. The other type has only a hole through the pin tong, the diameter of which is the same as that of the holes in the joint (Figure 19). For the latter type of pin tong, a rivet made of brass wire is used. Brass wire for rivets comes in small bundles of assorted diameters and may be purchased at jeweler's supply houses, or rivets may be made from brass or German silver wire on hand if it is of the correct gauge.

In fitting the type of pin tong which has the rivet attached (Figure 18), it is necessary only to spread the two sides of the joint apart with chain pliers, before fitting it to the holes in the joint and pressing the two sides of the joint tightly up against the shank of the pin tong with the chain pliers. The assembly is now ready for riveting, which means that the ends of the rivet will be turned over by hammering them lightly to form a slightly mushroomed shape. Since the space between the back of the pin and the rivet is too small to allow for using a hammer, it is necessary to use a special tool with a flat or slightly domed end to spread the end of the rivet. To make the riveting tool, use a ⅛" square piece of tool steel about 4½" long. Round the working end of the tool a little by rubbing it on #3/0 emery cloth. Polish it on #3/0 emery paper.

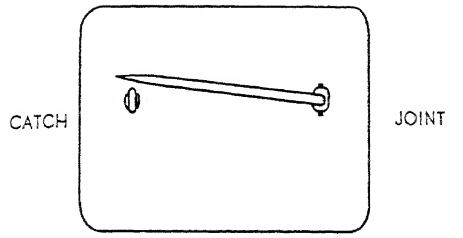


Figure 16

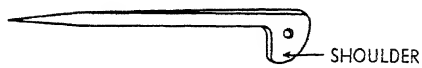


Figure 17

Figure 18

Figure 19

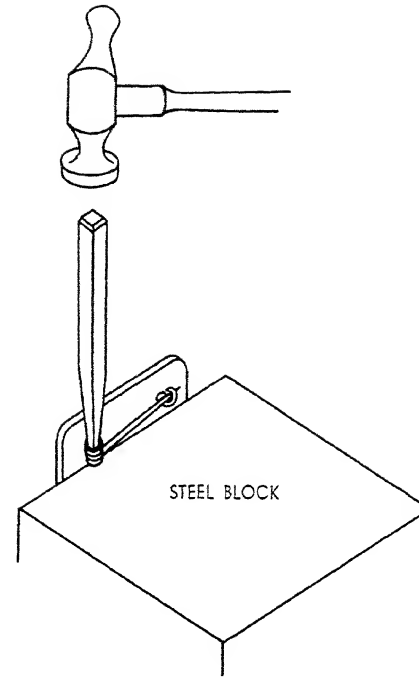


Figure 20

During the riveting operation, have the pin tong engaged with the catch. Place the pin edgewise along the edge of a steel block, with the joint resting on its side on the block (Figure 20). Hold the riveting tool in a vertical position, with the polished end on the rivet, and tap lightly six or eight times with a chasing hammer. When one end of the rivet is done, turn the pin over on the block and tap the other end of the rivet. This completes the riveting of the pin tong. The pin is now finished.

To rivet in the type of pin tong which does not have the rivet attached, the procedure is the same as described above, except that a rivet must be made by the worker. By trial select a piece of brass wire which will fit tightly in both the holes in the joint and the pin tong, or use wire of the right size from those on hand. Place the shank end of the pin tong between the two sides of the joint, and with pliers, press the sides tightly against the pin tong. Push the brass wire into the holes until its end is flush with a side of the joint. With the jeweler's saw, cut it off on the other side, at a point which allows it to project beyond the side of the joint to a distance of about one-third of its diameter. This amount allows a projection of about one-sixth of the diameter of the rivet on either side of the joint. The projections are equalized during the riveting. After sawing off the brass wire, rivet in the way described for the other type of pin tong.

PROJECT VI: APPLIQUÉD WIRE DESIGN

for Pins and Other Jewelry

Materials: 20 gauge silver or copper wire, about 20"; 20 gauge sheet silver or copper, size will depend on the size and shape chosen for the piece; catch and joint for hard solder; pin tong; 18 gauge lead wire, about 20"

Tools and Supplies: metal shears or saw frame and blades; needle files; flat-nose and chain pliers; rawhide mallet; hardwood block; cardboard about 6" x 9"; #3/0 emery cloth; #3/0 emery paper

Tools and Supplies for Soldering, Pickling, Oxidizing, and Polishing in addition to those above (see pages 89, 91, and 92)

Appliquéd wire design is a method of decorating jewelry by soldering wires onto a metal background.

DESIGN The method is simple and easy to learn, but as in all crafts the effectiveness of the piece will depend on the excellence of the design. The beginner is therefore urged to give his first attention to the design. The particular problem is that of devising a pleasing line pattern out of wire to contrast with a metal background.

You can make a design by repeating a unit like a loop, wave, a rectangular, or a triangular motif on a rectangular background (Figure 1). You can make two or more harmonious or contrasting units and balance them symmetrically or asymmetrically on the background, arranged separately or interlocked (Figures 2 and 3). Modern design favors the asymmetrical arrangement. Organic background shapes, with organic linear appliquéd designs, may also be tried (Figures 4 and 5). In the latter type the whole wire may be confined within the contour (outline) of the plate (Figure 4), or the wire may be allowed to extend beyond the outer contour of the piece or pass over openings sawed in the plate (Figures 5 and 6).

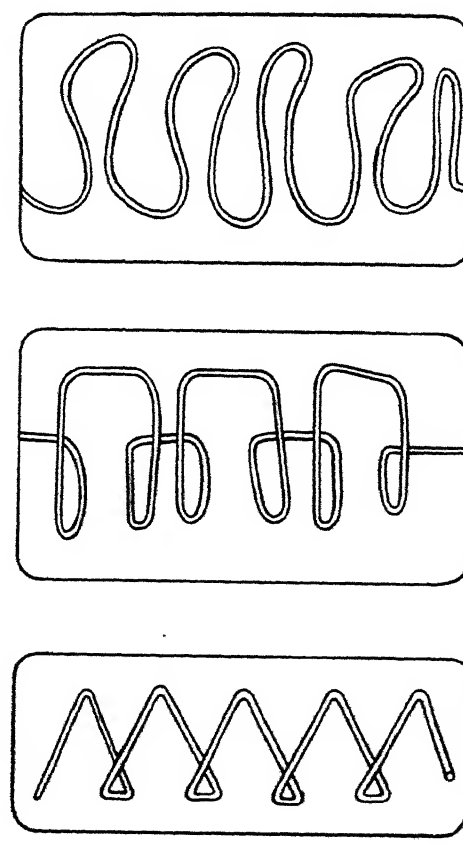
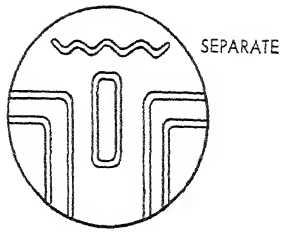


Figure 1



SEPARATE

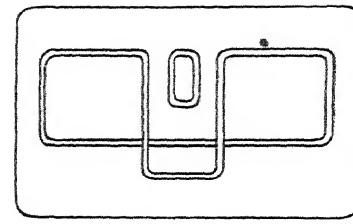
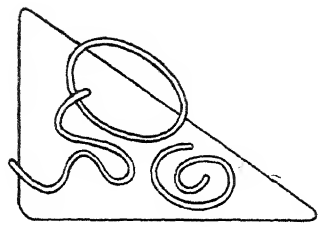


Figure 2

SYMMETRICAL



INTERLOCKED

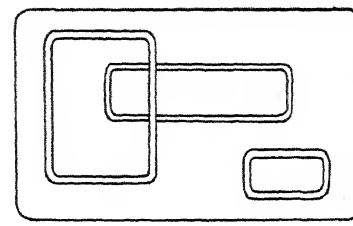


Figure 3

ASYMMETRICAL

In designs where animal shapes or any natural shapes are used, realistic imitation of these forms should be avoided. Good design demands that proper use of the material be given first consideration. In this project the metal, in wire form, must impose its character on whatever shapes the designer has in mind. This means that you will let the wire guide you in making the most interesting and rhythmic shapes and not force it to represent some realistic motif. If this idea is understood, stylization of natural forms will result automatically. For suggestions and ideas helpful in designing with natural forms, the beginner is referred to illustrations on pages 47, 49, and 65.

A good way to begin is by making trial designs out of lead wire and then arranging them against a piece of cardboard. The lead is easy to work as it can be shaped with tools and fingers. Cut out one or more background shapes of cardboard to represent the silver or copper blank to be used in the finished piece. Remember that the contour of the blank is an important part of the design and whether it be circular, rectangular, or organic in shape, it should be considered when the inside linear pattern is planned. Shape the line design out of lead wire. Study it against the background, altering the design if it does not suit you. When you have a result you like, make the finished pin.

Figure 4

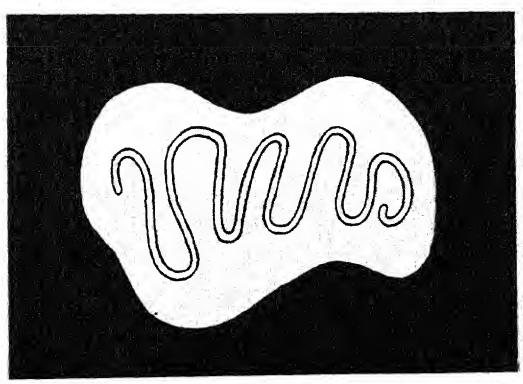
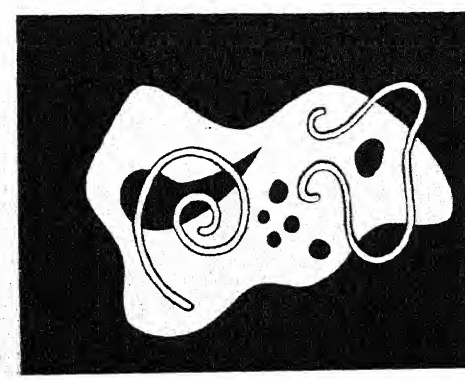


Figure 5



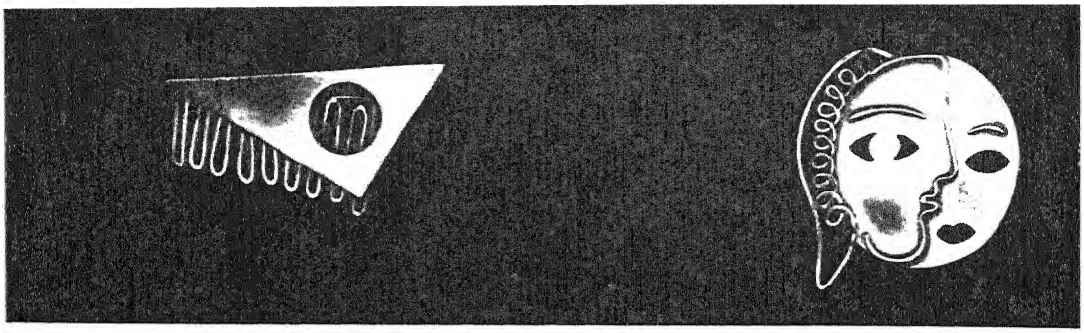


Figure 6 Handmade silver pins by Mabel D'Amico.

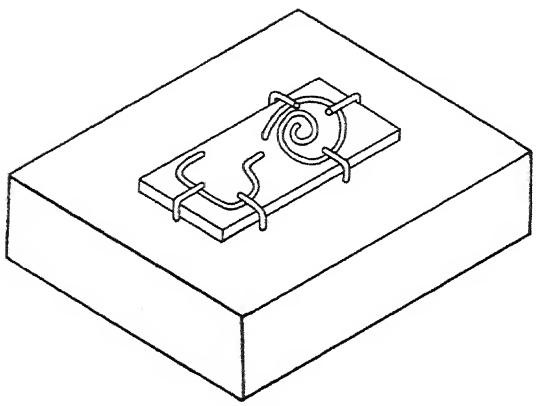


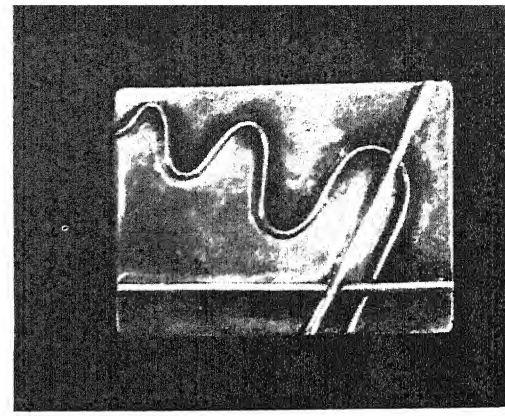
Figure 7

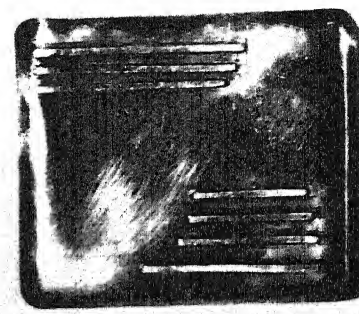
Figure 8 Press right-angle pins in with flat-nose pliers.

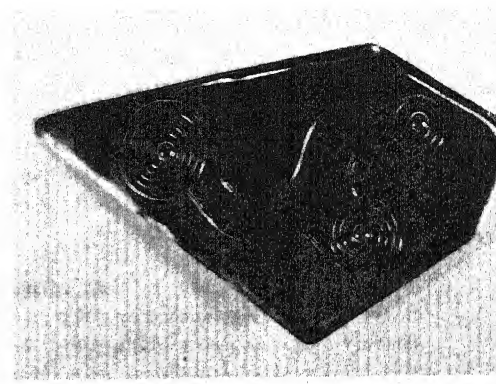
PROCEDURE Make both wire and background out of the same metal, or choose contrasting metals, such as silver and copper. Bend the wire with pliers to conform to the trial design made in lead wire. To make the wire lie level against the background, flatten it by tapping it lightly with a rawhide mallet on a hardwood block.

Saw or cut out the blank for the background and file the edges smooth with a needle file (see pages 30 and 31). Finish the edges with #3/0 emery cloth, followed by #3/0 emery paper. Prepare the wire and the background blank for soldering. Scrape the back of the wires and the areas under the wires where they touch the blank. Lay the blank on the charcoal block and arrange the wire design according to the original plan. Fasten the wire to the plate with right-angle pins made of 16 gauge binding wire (see page 26) driven into the charcoal block (Figures 7 and 8). Press these in gently but firmly with flat-nose pliers at enough places to hold the wire design in place. Put pellets of easy-flowing silver solder against the wire design with a flux brush at intervals of about ⅜". Heat the piece evenly with a medium flame. Do not try to melt the pellets of solder by directing the flame on them. They will melt easily as the entire piece is heated or when it turns a dull red (see page 90). Cool by immersing the pin in water. Now turn the pin over and solder the catch and joint (see pages 32 and 33).

When the catch and joint have been soldered on, pickle, wash, oxidize, and polish as you did in Project IV (see pages 26 and 91-93). Polish the pin with a hand or motor buff, leaving the areas near the wires oxidized in order to provide greater contrasts (Figure 9). Finish by fixing the pin tong to the back of the pin (see page 32).







Figures 9, 10, 11 Pins by veterans.

Figure 9 (top) Leave areas near the wires oxidized to provide contrasts.

PROJECT VII: APPLIQUÉD METAL DESIGN

A Pin Decorated by Soldering Plate on Plate

Materials: **2 pieces 20 gauge sheet silver, 2⅜" x 1⅝" or any other size or shape depending on your design; catch and joint for hard solder; pin tong**

Tools and Supplies: **saw frame; 2 or 3 #2/0 saw blades; needle files; large double-cut medium file; hand drill; #50 twist drill; metal snips; carbon paper or glue; #3/0 emery cloth; #3/0 emery paper**

Tools and Supplies for Soldering, Pickling, Oxidizing, and Polishing in addition to those above **(see pages 89, 91, and 92)**

DESIGN In planning the design for appliquéd metal it is important to know that several varieties of "plate on plate" are possible; for example, two or three layers of soldered plates, one upon another may be used (Figures 1, 2, 9 and 12). The metals employed may be the same or they may be varied. Silver may be soldered to silver, or the base plate may be of silver, the second plate of copper, and a third plate may be of gold or brass. A variation may be devised by introducing a pierced design as described in Project V, and then soldering the pierced plate onto a base plate with the addition of appliquéd shapes (Figure 3).

The problem of designing a "plate on plate" project should be approached by making a preliminary design on paper with pencil or brush and ink, or by cutting shapes from different toned or colored papers with ordinary scissors, and arranging them in a pleasing order. Strive for variation in shape, size and spacing. Ideas for designs may be inspired by the paintings of Arp (Figure 4), Braque, Picasso, and Léger.

PROCEDURE When you have made a satisfactory design, it may be transferred to the metal by tracing the contour with carbon paper or glueing it to the silver. Saw the base plate with your #2/0 saw blade (Figure 5). Fix it in the saw frame with the points down and hold it vertically, working it up and down, but do not push it (see page 30). On your second piece of silver lay out the pieces or shapes to be joined to the base. These can be arranged close together to save silver (Figure 6). Let us assume that you have made a design like the one in Figure 2. OF COURSE IT IS HOPED THAT THE BEGINNER WILL MAKE HIS OWN DESIGN AND NOT COPY ANY OF THOSE SHOWN IN THIS BOOK.

Saw out the shapes and smooth all sawed edges and round off the top edges of the top pieces or plates with needle files. The operation of soldering a plate to a plate differs somewhat from the ordinary set-up for soldering in that the solder is first melted onto the underside of the top pieces. This operation is known technically as "sweating." The primary reason for "sweating" is to avoid the showing of an unnecessary amount of silver solder at the outer contours (or edges), where the top pieces join the base plate. If done successfully, only a tiny thread of silver will show at the joining.

Figure 4 ***Mountain, Table, Anchors, Navel,*** **oil on cardboard with cut-outs, by Jean Arp; from the collection of the Museum of Modern Art.**

To prepare for a "sweated" joint, scrape the underside of the top pieces or plates throughout their whole area with the scraper, and paint with soldering flux. Distribute six or eight pellets of easy-flowing silver solder, depending upon the size of the area, over the area of each piece which is laid bottom side up on the charcoal block, and apply the blowpipe flame until the solder melts and forms a thin even film of silver solder over it. Do one piece at a time. If lumps of solder remain, they should be filed off, in order to bring the plates into close contact.

Hold the top pieces or plates, depending upon the type, on the base plate, and with a sharp pencil, trace the contours of all shapes. You can trace the shapes from the original design with carbon paper first to get their position, but it

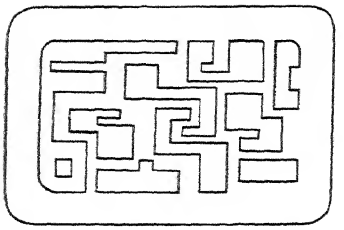


Figure 1

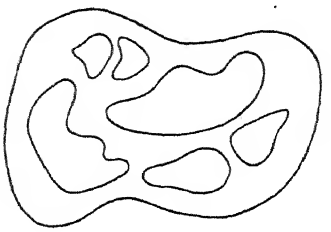


Figure 2

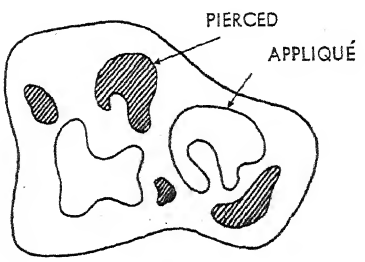


Figure 3

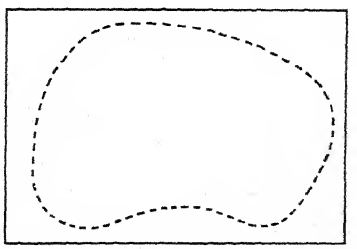
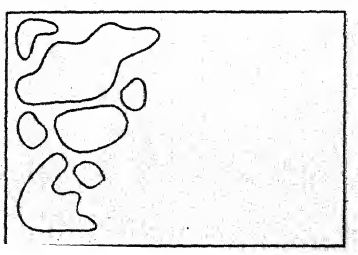


Figure 5

Figure 6



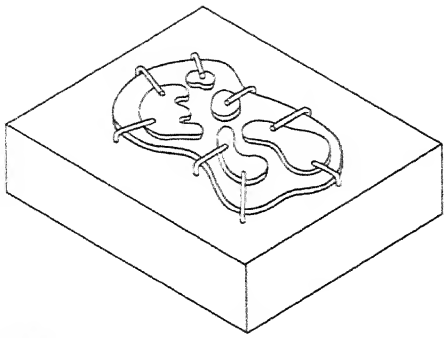


Figure 7

Figures 8 and 9 (above) Rings by veterans.

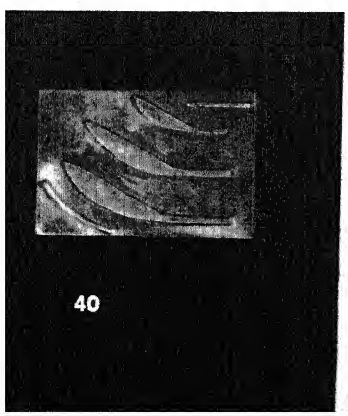
Figure 10 (below) Tie clasp by a veteran.

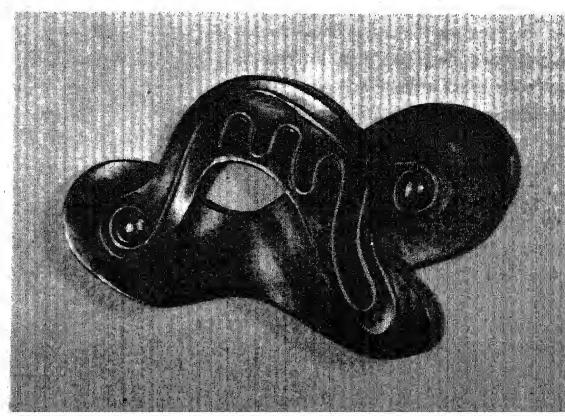
is suggested that you trace around the sawed-out shapes for accuracy because they may have been altered in the sawing. Note that the design must be reversed if you use initials, otherwise they will come out backwards in the finished piece. With the scraper, scrape all areas contained within the contours and paint them with flux. Pin both base and top plates to a charcoal block with 16 gauge right-angle binding wire pins (Figure 7). (See page 26 for making right-angle pins.) Apply the blowpipe flame, striving to bring both base and top plates to the same temperature at the same time, until a tiny thread of molten solder appears along the whole contour of each piece. If the design requires a third layer or plate, proceed according to the explanation above. The piece is now ready for soldering the catch and joint (see pages 32 and 33).

Pickle the pin, oxidize in liver of sulphur, and polish with a hand buff and rouge (see pages 91 and 93). Clean off the surface with the buff leaving the edges around the appliquéd pieces oxidized to give contrast. The piece can be left bright if it is so desired, in which case polish it with rouge and brush only. For a semi-mat finish, rub it with pumice and a rag or with fine steel wool. In either of these cases it is not oxidized.

The appliquéd metal process can be used with other processes such as appliquéd plate with wire and piercing (Figures 3 and 12). This variation can be tried out at this point if you have done the earlier project. You can also apply this process to rings and tie clasps (Figures 8-10), or include set stones (page 58, Figure 18), or other processes described in later projects as you master them.

Figures 11 and 12 Pins by veterans.





PROJECT VIII: RINGS MADE OF WIRE

Material: a variety of silver wire of different shapes—round, square, or half-round, or of different gauges, for example 14 to 16 gauge, for the simplest type (actual size and length of wires to be determined by the design and size of the ring to be made), approximately 3" for the length of each wire

Tools and Supplies: ring gauge; ring mandrel; bench vise; metal snips; rawhide mallet; saw frame; #2/0 blades; medium file; flat-nose and chain pliers; camel's hair brush; yellow ochre

Tools and Supplies for Soldering, Pickling, Oxidizing, and Polishing in addition to those above (see pages 89, 91, and 92)

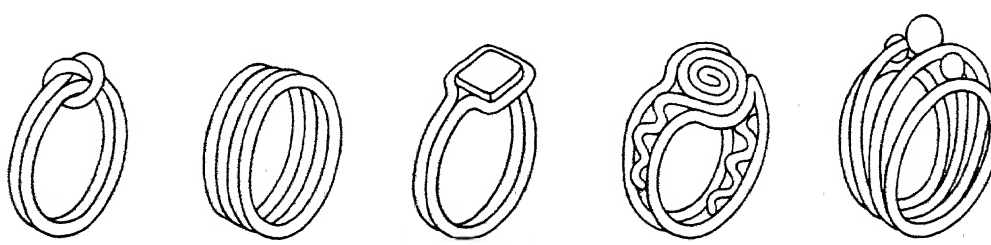
Rings made of wire are an interesting variation on the commoner types of ring, such as those made of sheet metal or by casting. The combinations to be had by using different numbers of wires and different kinds of wires are almost limitless. The rings may be made entirely of wire or they may contain stones. Some types are flat in cross section so that the wires touch the finger throughout their length (Figures 1 A-D and 14), while others have a three-dimensional shape somewhat resembling an inverted basket (Figure 1 E).

Only a few of the simplest types of wire-ring construction are described in this project, but it is hoped that through the experience gained in making them, the beginner will be able to design and construct the more complex types such as three-dimensional rings and rings with set stones.

Simple Type of Wire Ring A very simple type of wire ring can be made by soldering three or more straight wires together and bending them to a circular shape. Interesting designs can be achieved by the variation of the size and shape of the wires; for example, alternating square and round wires or wires of different size gauges, such as 14 and 16 gauge (Figure 2).

PROCEDURE To make this type of ring, begin by determining the size of the finger, either with the ring gauge (see page 55), or by wrapping a narrow strip of paper around the finger and marking it where the end of the paper meets the strip (Figure 3). Cut off the pieces of round, square, or other shaped silver wire a trifle longer than the required length, to allow for filing the joint. Scrape each one along its full length and paint it with flux in preparation for soldering. Pin all the wires to a charcoal block with right-

Figure 1



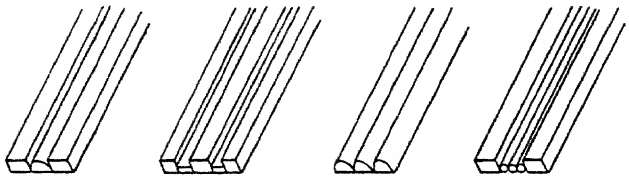


Figure 2

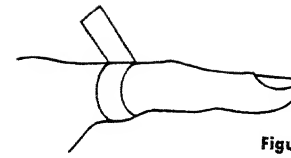


Figure 3

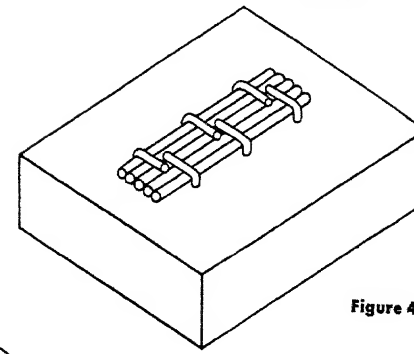


Figure 4

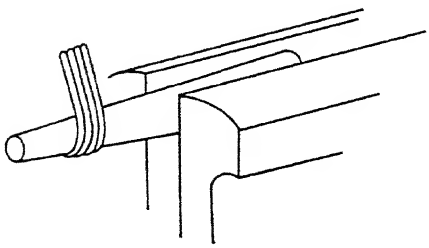


Figure 5

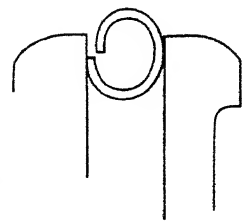


Figure 6

angle iron binding wire pins (Figure 4). Cut many pellets of hard silver solder and place them along the contact points of all wires, spacing them at intervals of about ⅜", then apply the blowpipe flame until the solder flows (see page 26).

When the piece is cool, bend it to shape on a ring mandrel held in the bench vise (Figure 5). Begin the bending at the ends with a rawhide mallet as you did the bracelet (see page 23). Put a pencil mark on the mandrel at the point where the ring you are making should fit. Try the ring at the point marked for size and saw off any extra length with the jeweler's saw. File the ends with a medium-sized file so as to form a close butt joint.

Shape the ring as follows to insure a tight joint. Bend the ends past each other over and under twice. If the ring is too stiff to bend with the pliers, the bending may be done in a bench vise (Figure 6). First bend one joint under the other, then reverse the ends. Finally bring the two ends together with pliers to form a butt joint. During the filing and shaping, test the joint for tightness by holding it up to a strong light.

Lay the ring on the charcoal block with the joint facing down (Figure 7), flux the joint and add pellets of hard solder ⅜" apart on the inside of the ring. Heat gradually until the flux dries and apply more heat, approaching the joint with the flame until the joint is soldered. Pickle, oxidize, and polish (see pages 91-93).

Variation of Simple Type A variation of this type of ring can be made by soldering two straight wires to the outside of a waving, zigzagging, or other motif as a center strip (Figures 8 and 15). This is similar to the designing and construction of the wire bracelet (Project IV), but because of the small size and necessary fitting, it requires greater accuracy. Use wires of 14 or 16 gauge with a center strip of 18 gauge or lighter.

It is important that each point of contact be well soldered. Solder these while they are flat and straight and later shape them on the mandrel; solder to a butt joint. Pickle, oxidize, and polish.

More Complex Type of Wire Ring A more complex type of ring can be made by the following method. Determine the finger size as before and cut two 12 gauge silver wires to that length allowing a little extra length for filing the joint. Cut two 6" pieces of 16 gauge wire to form the decoration on the ring. Spread the two short wires and place the 6" pieces between them as shown in Figure 9, so that they will not be soldered at these spots. Section A will form the part of the ring on the underside of the finger; its length should be roughly one-half the total circumference. Prepare to solder the three elements at Section A by scraping or light filing. Bind them with the fine iron binding wire, making a spiral binding. Paint the section with flux and apply pellets of solder where wires are in contact. About six regular-sized pellets should suffice. Proceed with the soldering, keeping in mind the light weight of the wires and the danger of melting them. Keep the flame moving along the entire section while soldering.

When the soldering is finished, remove the binding wire and shape the ring on the ring mandrel or with pliers, bending only the two outer wires and leaving the center wires as shown in Figure 10. Prepare these outer wires for joining by first testing them for size on the mandrel at the exact point marked (see page 55), then filing their ends to form tight butt joints. Spring the ends of the wires together past each other, using the fingers or pliers, then spread them apart until they engage. The ends of the wires will now be pressed tightly together. If they are not sprung against each other in this way, the joint will tend to separate when heated, owing to the expansion of the metal.

Figure 7

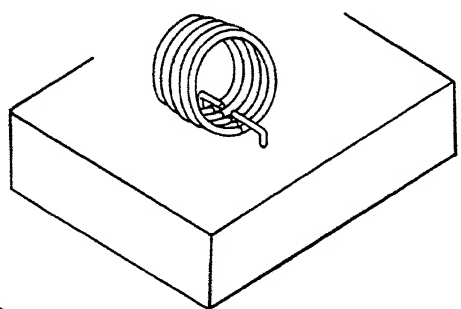
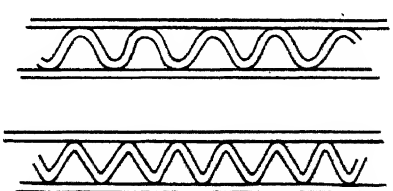


Figure 8



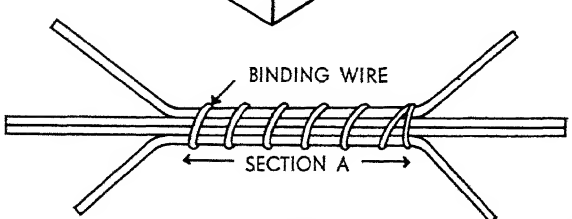


Figure 9

Figure 10

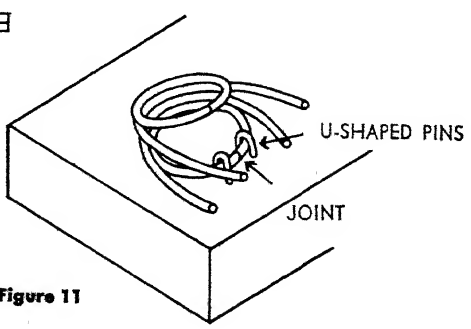


Figure 11

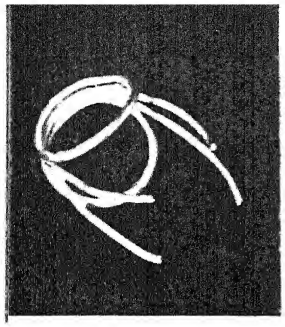


Figure 12

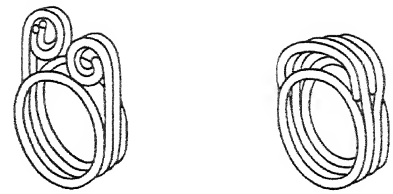


Figure 13

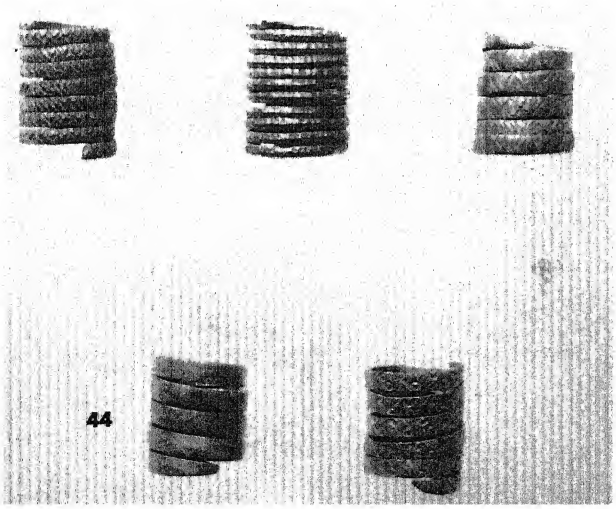
Place the ring on its side on the charcoal block, pinning one or the other of the side rings to the block with U-shaped binding wire pins (Figure 11). Proceed to solder the joint as explained above. When one of the sides is done, turn the ring over and solder the other side in the same way (Figure 12).

The formation of the ends of the central wires into decorative motifs now remains. The decoration must harmonize with the triangle formed by the side wires and must be completed in a motif at the top. The wires can go up straight, be waved or twisted to form the inside decoration, and cross each other or make spirals at the top. Two treatments are suggested (Figure 13). The central motif at the top may be made to stand above the finger, or it may spread out beyond the ring. These are suggestions only; the designer is free to invent other motifs. If you have too much wire, cut off the excess. Solder all contact points for support where it is needed.

You can make a second ring with more than two interior wires and form them into a design at the side and top. Three or four interior wires may give a better effect and allow for more inventive designing than two, but of course too many wires will cause trouble in construction as well as complicate the design.

After the ring is completed, clean off any excess solder that remains with needle files; pickle, oxidize, and polish (see pages 91-93).

Figure 14 Brass finger rings, Boyobo, Philippine Islands. Photo from American Museum of Natural History, New York.



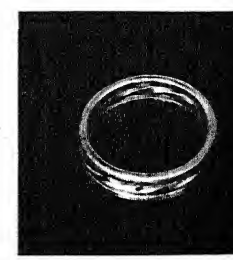


Figure 15
By a veteran.

Figure 16
By a veteran.

PROJECT IX: STAMPED DECORATION

Copper or Silver Bracelets

Material: 16 gauge sheet copper or silver, 7½" x 1" for closed bracelet, 6" x 1" for open type (or wider than 1" if desired)

Tools and Supplies: metal snips; anvil or polished steel plate 4" square, 1" thick, or heavier; shaped steel stamping tools, 3/16", square and round, and approximately 4" long; needle files; half-round medium-cut file; machinist's hammer or any heavy hammer; chasing hammer; rawhide mallet; bracelet mandrel; bench vise; camel's hair brush #5; cardboard or illustration board; gray tempera paint; cloth; #3/0 emery cloth; #3/0 emery paper

Tools and Supplies for Annealing, Oxidizing, and Polishing; and if desired for Soldering and Pickling, in addition to those above (see pages 88, 89, 91, and 92)

Stamping as a method of decorating jewelry is much used by the Indians of the American Southwest. Simple patterns are made in the metal by means of steel dies, the designs are dependent upon the shapes of the tools available and the ingenuity of the craftsman in combining them. The accompanying designs are shown to give the beginner an idea of the kind of tool patterns recommended (Figure 1). Figure 2 shows a complete tool. Figure 1 shows the basic shapes as indicated by the tool ends.

DESIGN It is recommended that designs be restricted at first to straight and curved lines of various lengths and simple geometric shapes such as squares, triangles, and circles (Figure 3). These shapes may be thought of as the basic elements of the design. Simple patterns can be made by repeating or alternating these motifs in rows. Combining them to make an interesting decoration is a problem in creative designing and calls for ingenuity and inventiveness (see opposite page, Figure 14; and Project X, Figure 7). A wider band of 2" or 3" may be used instead of the 1" width suggested, and several rows of designs may be repeated or a random design may be chosen (Figure 4).

Figure 1

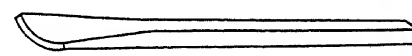


Figure 2

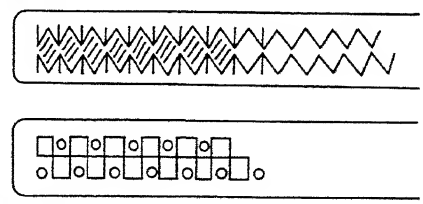
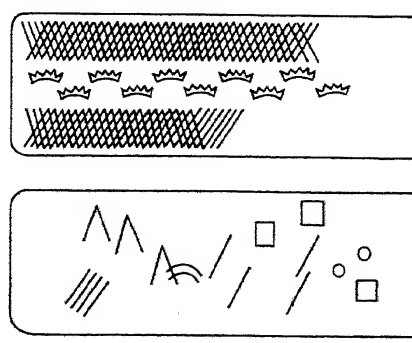


Figure 3

Figure 4



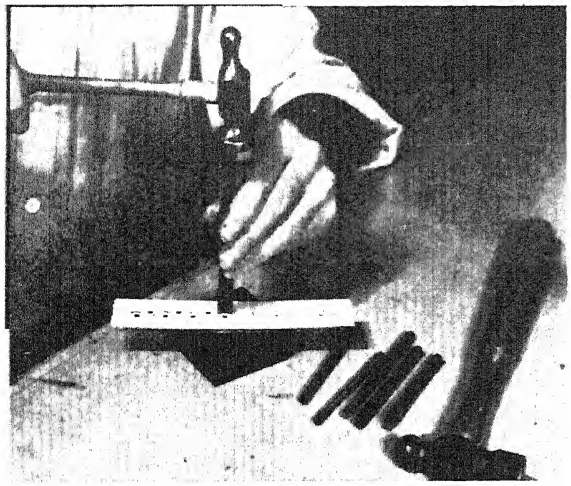


Figure 5

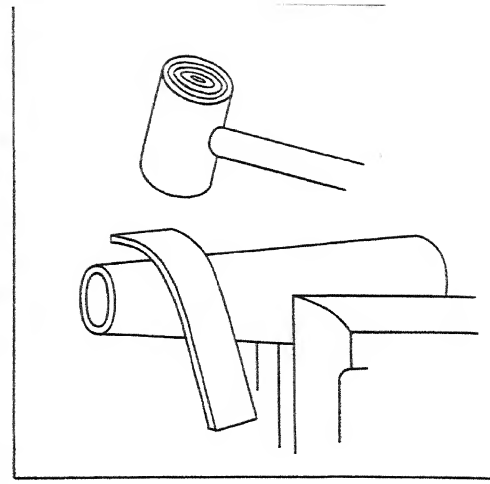


Figure 6

When several tools have been selected, trial patterns may be made by stamping on strips of cardboard or illustration board which will enable you to see the effect of your design quickly and will save metal. Try the patterns out by hammering the tools with a chasing hammer (Figure 5). To reveal the stamped design quickly, cover the whole strip with a wash of dark gray tempera paint or poster paint, then immediately wipe the color off the surface of the cardboard with a cloth. The stamped design will stand out dark against a light background.

PROCEDURE When a design has been decided upon, it may be transferred to the metal strip with carbon paper or drawn on freehand. The copper or silver strip should be annealed before the design is transferred to it (see page 88). Flatten the metal with a rawhide mallet on a hardwood block if necessary (page 21, Figure 3). Now place the strip on the polished side of the steel plate and, with the tool in position on the design and held perpendicular to the strip, give it one sharp blow with the hammer (Figure 5). Be sure to use the heavy (ball pein) hammer this time, not the chasing hammer. Note that the illustration shows trying the design out on cardboard which is why the chasing hammer is used. The impression of the tool should be about 1/32" in depth. Test the amount of force necessary for the hammer blow by experimenting first on a scrap of waste metal. The larger the area of the die, the heavier the blow must be. It is advisable to practice on a piece of scrap copper first until you gain some skill in using the tools.

Next, fasten a steel or maple bracelet mandrel in a bench vise in a horizontal position, using copper or brass jaws in the vise to protect the mandrel. Bend the bracelet over the mandrel by hammering it with a rawhide mallet, beginning at the ends of the bracelet and working gradually toward the middle part (Figure 6; and page 23, Figure 6). If the bracelet is of the closed type, fit the joint, bind it (see page 89, Figure 3), solder and pickle. Finish all the edges with files and emery cloth. In order that the stamped design be revealed clearly, the bracelet should be oxidized, cleaned with pumice powder, and finally polished with rouge. If a mat surface is desired, finish only with wet pumice powder (see pages 92-93).

PROJECT X: REPOUSSÉ DECORATION

True Repoussé

Materials: 24 gauge sheet silver, 2¼" x 1¼"; joint and catch for hard solder; pin tong

Tools and Supplies: pitch bowl with pitch; blowtorch; ring pad or other support; hammer; chasing hammer; repoussé tools; needle files; half-round medium file; metal snips; carbon paper; stick of wood; cloth; #3/0 emery cloth

Tools and Supplies for Soldering, Pickling, Oxidizing, and Polishing in addition to those above (see pages 89, 91, and 92)

The French term "repoussé" is used to describe a method of decorating metal by raising designs in low relief on it. The literal meaning of the word is "thrust back," referring to the way in which the relief is raised, that is, by hammering the design out from the reverse side of the metal. The metal to be decorated is fixed, face down in jeweler's pitch, and is then beaten down against the pitch with a repoussé tool and hammer. The depressions made on the back appear as raised lines and areas on the face of the metal.

DESIGN A trial design for repoussé may be made by using thin gauge copper as explained in Project I. The first project should be very simple in design (Figure 1). Straight and curved lines combined with simple geometric areas will present a difficult enough problem. Later, designs such as shown in Figures 3 and 8 offer excellent suggestions. The beginner should also study the catalogs: *African Negro Art, Indian Art of the United States,* and *Arts of the South Seas,* published by the Museum of Modern Art,

Figure 1 Design of straight and curved lines and geometric areas.

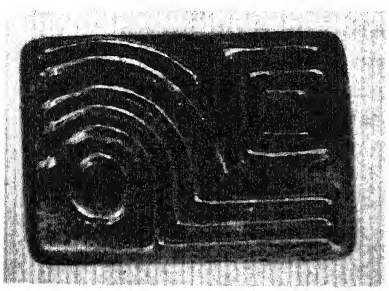


Figure 2 (left) Gold bracelet, from Mixtec burial, Oaxaca, Mexico.

Figure 3 (right) Chimu silver cup, embossed, Piura Valley, Mexico.

Both photos from *Medieval American Art*, by Pál Kelemen, Macmillan Co., 1943.

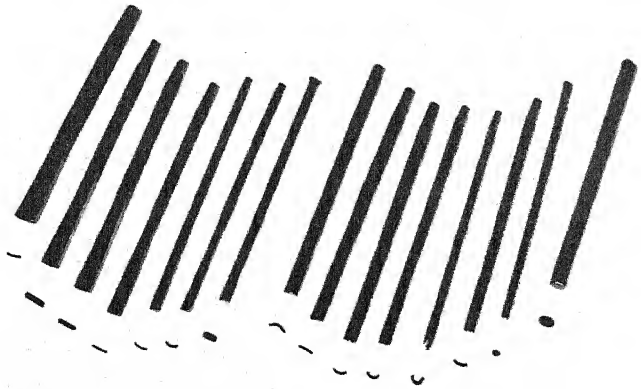


Figure 4

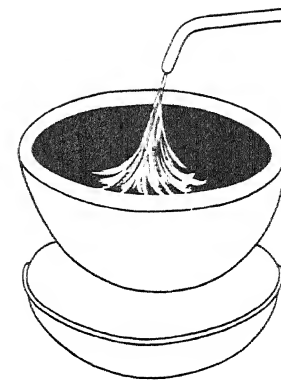


Figure 5

because they contain excellent examples of designs in wood, metal, and textiles which may be adapted to, or modified for, repoussé design. In most of these designs, surfaces are enriched by lines and areas, used in a simple geometric manner. Wherever natural, animal, or floral forms are used, they are highly stylized. The beginner is advised to study these design sources for type and style, and for suggestions, but not, of course, to copy them. Because of the difference of the crafts and the material used, the beginner should adapt these designs to suit the nature of the metal and the repoussé process.

If the beginner confines himself to straight and curved lines and simple geometric areas, his design may be executed with the commonest repoussé tools, obtainable in jeweler's supply shops (Figure 4).

PROCEDURE When a satisfactory design has been made, the silver sheet should be prepared to receive it. Be sure that it is annealed. Clean the silver by rubbing the back or reverse side with a wet cloth dipped into pumice powder. Then transfer the design to the metal by means of carbon paper. In order to give support at the edges during the repoussé process, cut the rectangle of silver somewhat larger than it is to be in the finished piece. Regardless of the shape of the finished piece, leave the sheet of metal in a rectangular shape until the repoussé work is done. Warm the pitch in the pitch bowl with the blowtorch, using gas only—no air (Figure 5). If the pitch starts to burn, blow out the blaze immediately to prevent the formation of cinders on its surface. A good and economical substitute for the pitch bowl is a shallow metal tray like a cookie pan. Melt the pitch into it until it is almost filled to the brim. When the pitch is soft and yielding, warm the silver sheet quickly, and with a stick of wood, press it into the pitch to a depth of about ⅛". Pat down the pitch which overflows at the edges of the silver, with a hammer. Allow about one-half hour for the pitch to cool, or place the pitch bowl under running cold water for about ten minutes. If the repoussé work is begun before the pitch is cool, the whole piece will tend to sink into the pitch during the hammering and the design will not be clear-cut.

Choose a tool that conforms to the lines of the design. For straight lines choose a straight liner, for curved lines use a curved liner as near as possible to the curve desired. To depress areas use a tool with a circular or oval-shaped end. Sharp contours cannot be achieved in repoussé work. The thickness of the metal tends to round lines at the edges of the areas. Be sure that the working end of the tool is always highly polished. Polish it by rubbing it occasionally during the operation on #3/0 emery paper. Do not confuse emery paper with emery cloth.

Tilt the tool slightly away from the body, and while tapping lightly with the chasing hammer, feed the tool along the lines of the design toward oneself (Figure 6). Turn the pitch bowl (or tray) as you work so that you can follow the lines conveniently. Many light taps with the

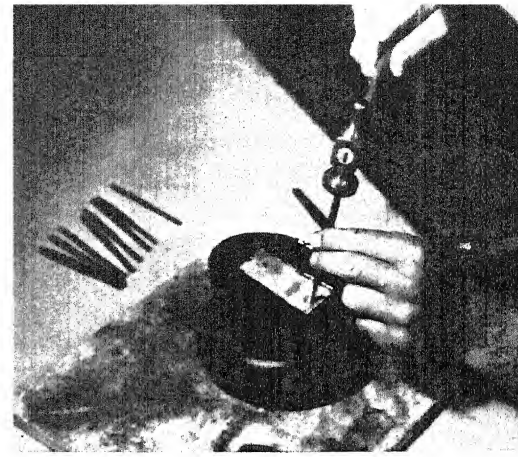


Figure 6

hammer will produce a smooth line, whereas a few heavy blows of the hammer will produce a bumpy effect. Go over the lines several times in this manner until the desired depth is reached. If there are flat areas in the design, they should be outlined first with the liner, then completed with a broad circular or oval-shaped tool. Continue hammering until the desired depth is obtained.

In making deeply raised designs, it may be necessary to remove the metal from the pitch, anneal it, and replace it in the pitch. Several annealings may be necessary. To remove the piece, insert a repoussé tool under one edge of the silver and give a sharp downward blow to the handle end of the tool, using it as a lever. If the piece does not come out, it may be necessary to warm the silver with the blowtorch and then remove it. Any pitch adhering to the silver will burn off during the annealing operation (see page 88).

Trim the edges of the pin with metal snips or the jeweler's saw. File the edges and finish with #3/0 emery paper. Solder the catch and joint with easy-flowing silver solder (see pages 32-33). Pickle, oxidize, and polish the piece (see pages 91-93). Oxidizing will help to bring out the modeling if the high spots are polished, but you may leave it bright if you prefer it that way.

After you have learned repoussé by making a pin, you can design any other pieces of jewelry using this process, for example bracelets (Figure 7), earrings, or pendants. You can also combine it with other processes such as piercing if you find the need for it. Experience and the spirit of exploration will help the beginner to extend and add richness to the projects given here.

Figure 7

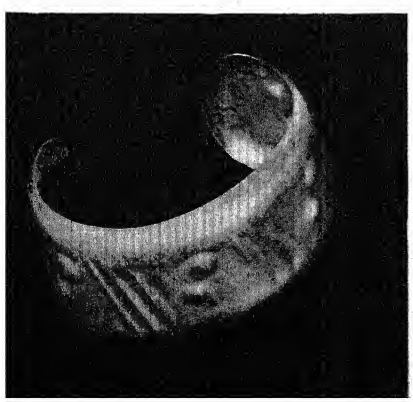


Figure 8 Bronze mirror, China. Photo from American Museum of Natural History, New York.

PROJECT XI: THREE-DIMENSIONAL DESIGN

Earrings and Other Jewelry

Materials: **24 gauge sheet silver (quantity depends on the number of earrings made, estimate 2 sq. in. to a pair); 6 sq. in. heavy paper or thin sheet lead; ear wires for soft solder**

Tools and Supplies: **paper scissors; metal snips; needle files; blowpipe; scraper; flat-nose, chain, and round-nose pliers; soldering tweezers; charcoal block; asbestos block; #3/0 emery cloth; #3/0 emery paper; stiff brush; soft solder; soft solder paste (flux)**

Tools and Supplies for Pickling, Oxidizing, and Polishing in addition to those above (see pages 91 and 92)

This project demonstrates how to develop forms out of a flat sheet of metal by first making patterns, shaping them, and assembling the parts. It is suggested that the beginner make trials first in paper or sheet lead, mold them to the desired form, then duplicate the result in silver or other metals. This will help him to visualize and improve his final design and will avoid waste of time and materials. Several exercises are described. You can choose one or more, or do all of them.

DESIGN First Exercise: Earrings designed on the vertical rhythm Cut a large triangular, oblong, or other shape about 2″ long in paper or sheet lead. You can vary the edge or proportion as you wish (Figure 1). Shape it to suggest three-dimensional form by coiling vertically, waving, or bending into planes (Figures 2 and 3) with fingers and tools.

PROCEDURE When you have a design you like, reproduce it in 24 or 26 gauge silver, which can be cut with snips. Remember to make two of them and to match them as opposites if that is a consideration. File the edges smooth and round them off with emery cloth and finish with emery paper. Anneal (heat) the metal first to make it more pliable (see page 88).

Shape the pieces with pliers exploring the best ways to get the desired effect. For example, in making a vertical coil, hold the bottom of the triangular piece of silver with flat-nose pliers in the left hand and with chain pliers grip the point and twist and pull at the same time. Bends can be made by holding the metal strip in one hand and bending with the pliers, gripping the piece sidewise on the designated lines (Figure 4). As you gain experience you will find the right tool and the right way to use it. When the shaping is done, remove all work marks and scratches with #3/0 emery cloth and #3/0 emery paper.

The last step is the soldering on of the ear wires. These are usually made of sterling silver and are stamped out by machine. The stamping operation makes them hard. In order to preserve the hardness they should be attached to the unit by means of soft solder (lead solder). This solder must not be confused with easy-flowing hard solder. Only soft solder flux must be used with soft solder. Soft solder melts at about 475° F., and because it flows at such a low temperature, the hardness of the ear wires is not affected.

Scrape the inside of the slightly saucer-shaped end of the wire. With a matchstick apply soft solder paste to this scraped area. Then cut a tiny piece of lead solder, trying to judge the right amount to just fill the saucer. Hold the ear wire

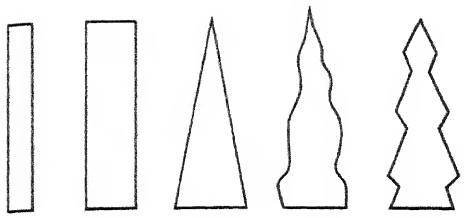


Figure 1

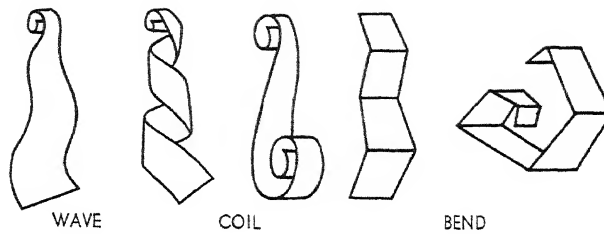


Figure 2

upright with soldering tweezers, place the piece of solder in the saucer and using a small flame apply heat to the underside of the saucer. The solder will melt in a few seconds. If there is too much solder it may be filed off until flat.

With a pencil, mark a spot on the edge of the unit to indicate the top, to insure the correct placement of the ear wire. Choose the place on the earring unit where the wire is to be attached, scrape and apply flux (soft solder paste) to the scraped area. Place the earring unit on the charcoal block face down. If necessary dig out some charcoal in order to keep the unit level and steady. Place the saucer part of the wire on the scraped part on the unit. In case it is necessary to

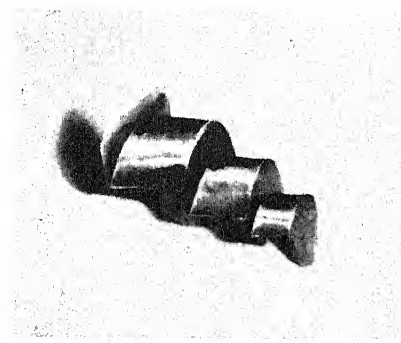


Figure 3 Finished earring.

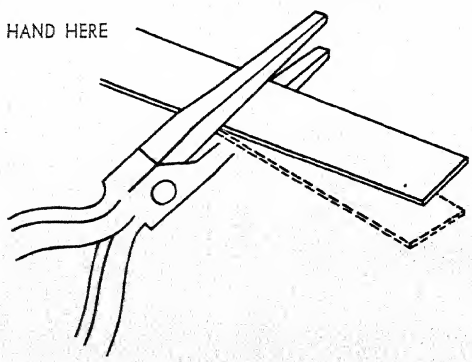
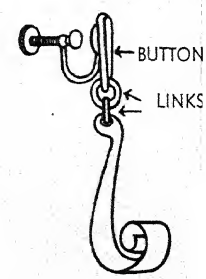


Figure 4

Figure 5



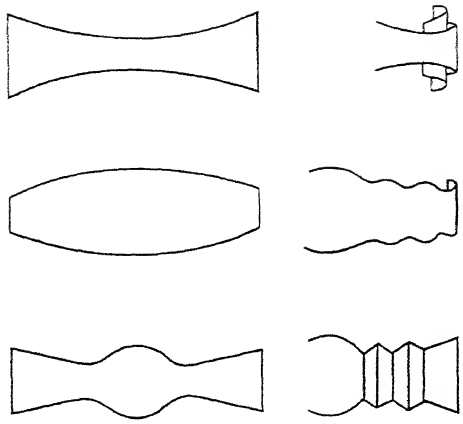


Figure 6

Figure 7

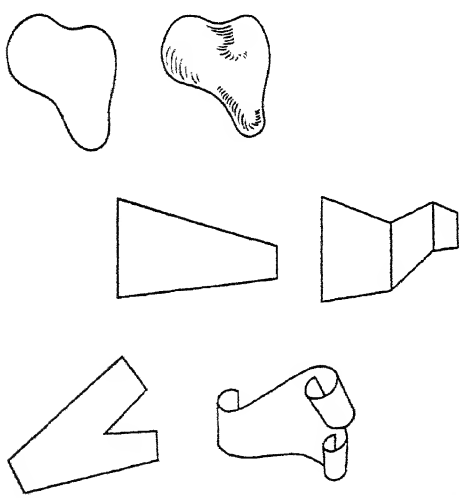
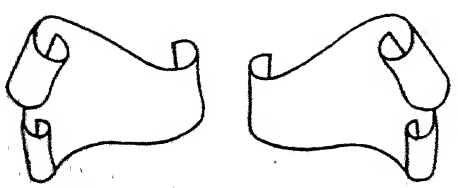


Figure 8

Figure 9



bind, use a right-angle iron binding wire pin pushed into the charcoal. Apply the heat with a small flame and melt the solder. Wait a few minutes before testing, as the heat in the piece may keep the solder in a molten state for a minute or two. An earring may be soldered to a button and the two rings attached to the ear wire so as to allow the earring to hang free (Figure 5). (See Project XVII, on Chain Making.)

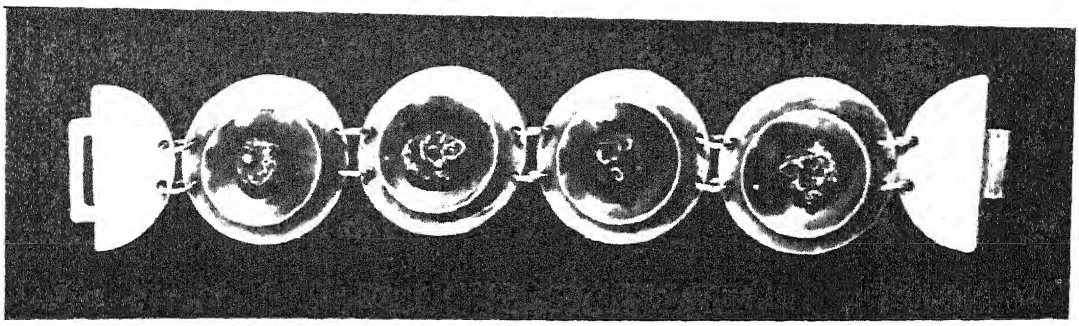
When the soldering is completed examine the piece and remove any superfluous solder with a sharp knife or needle file. The solder paste must be removed by brushing with hot water and soap as pickling does not remove it. Pickle the piece, then oxidize and polish (see pages 91-93).

Second Exercise: Earrings designed from symmetrical or asymmetrical shapes

For symmetrical designs cut a symmetrical shape about 2" long out of paper or sheet lead (Figure 6). You can coil the ends toward the middle or wave or bend them as you wish (Figures 7 and 13). Duplicate in silver and solder to ear wire, pickle, and polish as described above.

An asymmetrical design is made from an irregular shape. Wave, bend, or coil the entire shape or the edges to suggest three dimensions (Figure 8). If it seems necessary, match the earrings so that they balance as opposites (Figure 9). This may be desirable when designing with asymmetrical shapes. When a suitable design has been made in paper or sheet lead, reproduce in silver and finish as above.

Three-dimensional jewelry may be made by applying other processes of construction such as plate on plate (Figure 10), or shaping the metal in a hollowed-out form in a hardwood or lead block with a machinist's hammer (Figure 11), or cup shapes may be made with the dapping tools and dapping die (Figure 12). The above exercises present a simple way of achieving three-dimensional forms. The craftsman may introduce other methods learned from the various projects as he sees the opportunity and as his design suggests it.



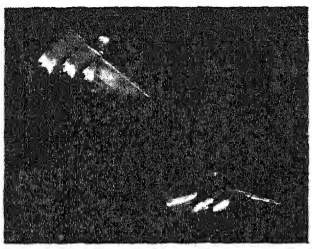


Figure 10

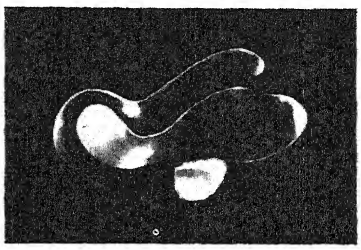


Figure 11
Pin by Hurst and Kingsbury.

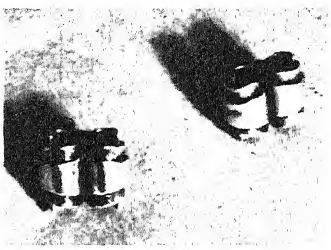
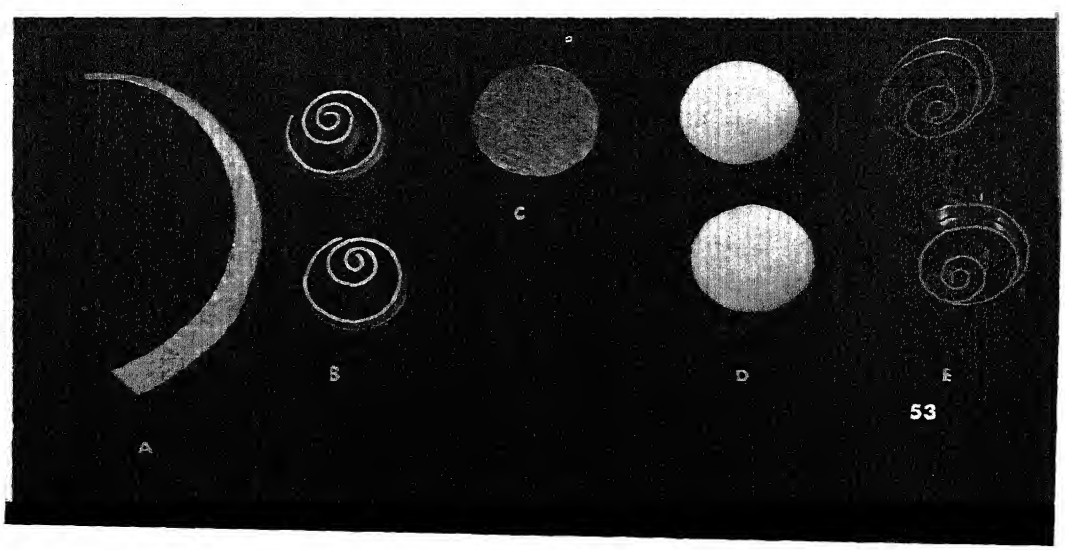


Figure 13
Earrings by a veteran.

Figure 12 (top) Bracelet by Hurst and Kingsbury.

Figure 14 Earrings in Spiral Design.

A—Pattern for spiral; B—Spiral; C—Back cut as a circle; D—Circles made concave by placing them one at a time over a rounded depression cut into the end of a wooden block and hammering them lightly with a round-end rawhide mallet or steel hammer; E—Spirals soldered to concave circles by pressing down to make good contact with back wiring and soldering. Ear wires soldered to back with soft solder.



PROJECT XII: RINGS WITH SET STONES

Materials: **18 gauge sheet silver, ¾" x 4"; a cabochon cut stone—garnet, cat's eye, carnelian, about ½" to ¾" in its largest diameter, or a ½" round stone; 28 or 30 gauge sheet silver, 1" x 2"; 28 gauge sheet lead, 1" x 4"**

Tools and Supplies: **saw frame; 2 or 3 saw blades #1/0; hand drill; #50 twist drill; metal snips; riffle files; needle files; bench vise; ring mandrel; wooden mandrel or ring clamp; ring gauge; rawhide mallet; pusher; curved burnisher; glue; #3/0 emery cloth; #3/0 emery paper**

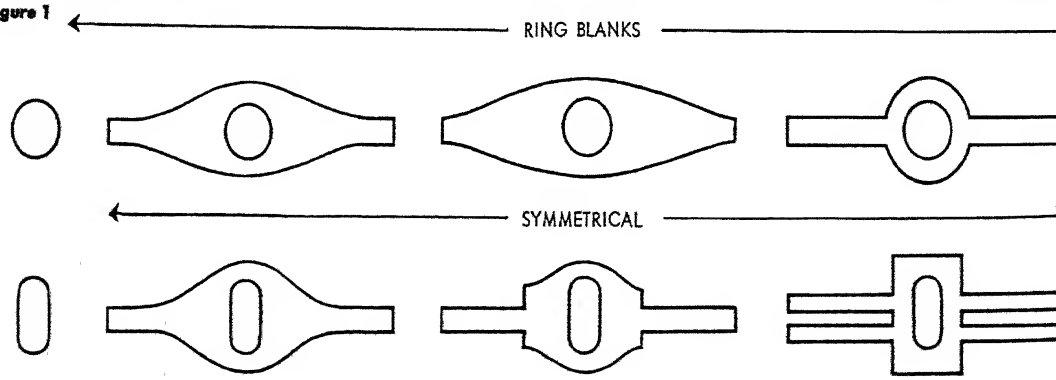
Tools and Supplies for Annealing, Soldering, Pickling, Oxidizing, and Polishing in addition to those above (see pages 88, 89, 91, and 92)

DESIGN Find finger size for the ring by using a ring gauge or by wrapping a narrow strip of paper around the finger (see page 42 and Figure 3, page 42). The design of the ring can be approached by making a model out of sheet lead. This will enable you to work out the construction of your ring and to see the design before you undertake working in silver.

First make a ring blank. This is a pattern of the ring spread out flat. Notice that the blank in Figure 7A is broader at the middle to accommodate the stone than it is at the ends where it fits under the finger. The width and shape of the blank are determined by the size and shape of the stone, its convenience in wearing, and the craftsman's feeling for design. For this project a cabochon cut stone, a stone with a smooth polished surface with no facets, has been recommended because it is easier to set. Synthetic stones can be purchased at modest prices from any lapidary (see page 7). The ring blank may have a number of variations, but it should be simple in design.

The following are examples of ways of designing blanks for stones of various shapes. Do not copy any of them, but design your own. The stone may be set in a symmetrical or an asymmetrical shape. Modern design tends to favor the latter because it is less traditional and offers more unusual possibilities. You can make such sketches as shown (Figure 1) with pencil and paper or you can cut them out of the cardboard.

Figure 1



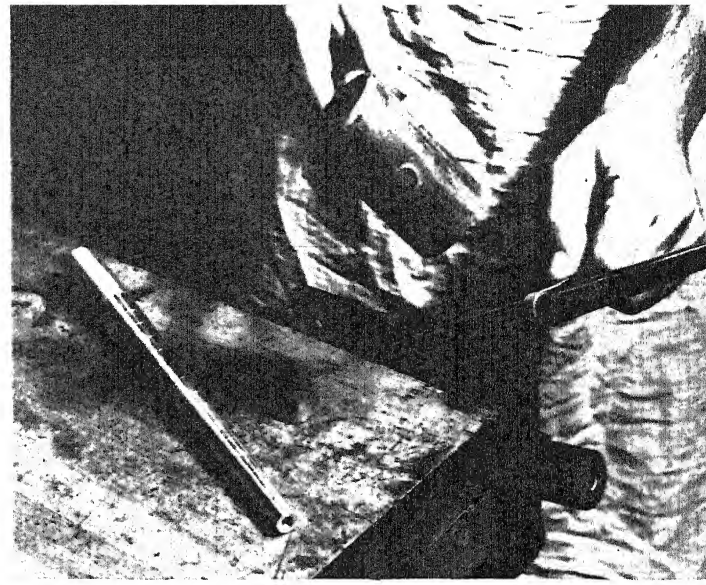


Figure 3

When you have a blank that pleases you, cut it out of sheet lead and shape it roughly by pressing it around the ring mandrel with your fingers. In this way you can see how the ring will look when it is constructed in three dimensions.

PROCEDURE When the blank of the ring has been decided upon, draw it on thin paper and glue the paper to the sheet silver (18 gauge) in preparation for sawing. Make the blank about 1/16" longer than actual size to allow for fitting a good joint (Figure 2). In this type of construction the joint comes on the underside of the finger. After the ring blank is sawed out, file it to the exact shape and round off all edges except the ends. It is much easier to do the necessary filing when the blank is in the flat.

Be sure the blank is annealed before bending it (see page 88). Fasten the ring mandrel firmly in a bench vise at a convenient angle and shape the ring over it with a rawhide mallet, beginning at the ends (Figure 3). Next prepare the joint by filing it to a good fit. Mark a point on the ring mandrel with a pencil by slipping the ring gauge or the paper strip of the size of your ring over the mandrel. Try the ring for size either on the finger or on the mandrel at the point marked.

If there is to be much subsequent soldering, it is advisable to use hard silver solder for this joint. Bind with 22 gauge binding wire and solder (see Figures 4 and 5, and page 89).

Set the shaped blank aside and start making the

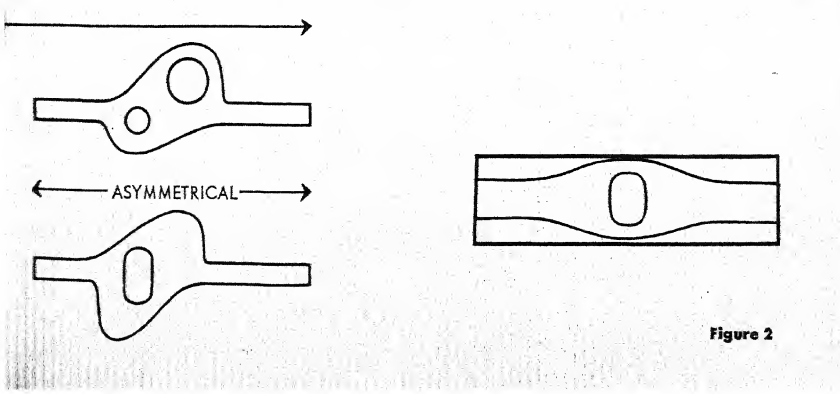


Figure 2

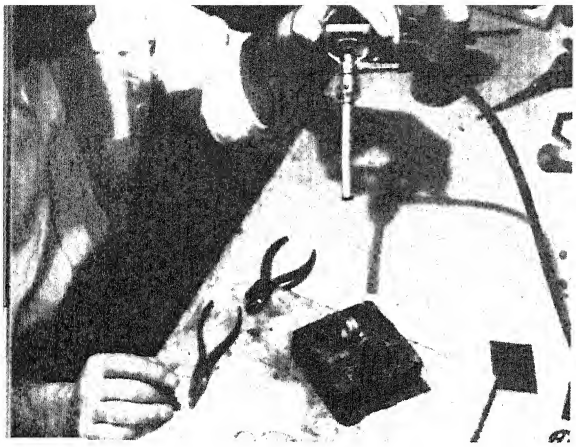


Figure 5

bezel. This is the name for the collar of metal which holds the stone. On a flat piece such as a pin or pendant the bezel may be a simple band of thin silver soldered onto the plate. This is sometimes called a box bezel. Since the ring you started has a curved or cylindrical surface, the box bezel cannot be used unless a table construction is made (see Figures 15 and 18).

Shoulder Bezel For a curved surface the bezel must be made in such a way as to provide a ledge or shoulder on which the stone rests firmly, and therefore this type of bezel is called a shoulder bezel. The shoulder bezel is made by hard soldering a narrow strip of 28 gauge sheet silver to a wider strip of the same gauge metal (Figure 6A and Figure 7C, E, and F). A wire may be used in place of the narrow strip (Figure 6B). Scrape all areas which are to be joined in preparation for soldering and bind the two strips together spirally with 22 gauge binding wire.

The widths of the strips are determined partly by the curvature of the ring itself, and partly by the size of the stone (Figure 8). In placing the shoulder, allowance must be made for filing the lower part of the bezel to fit the curve of the ring. In filing, be sure the top of the curve does not come up to or above the shoulder. The amount of bezel above the shoulder is determined by the size and cut of the stone (Figure 9). The stone on the left requires more metal above the shoulder than does the one on the right. There is no general rule for judging the height of the bezel above the shoulder, but there must be enough metal to hold the stone when it is pushed against it.

Because it is often difficult to get a good fit, it may be advisable to make a pattern for the bezel out of paper or sheet lead and fit it to the ring. This can be used to help trim the lower part of the silver bezel by tracing around it and filing to the line. After carefully fitting the bezel to the ring, scrape the ring where the bezel is to join it, and solder, using easy-flowing solder (Fig. 7G).

Figure 4

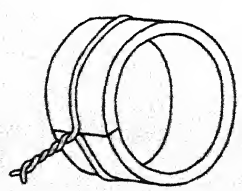
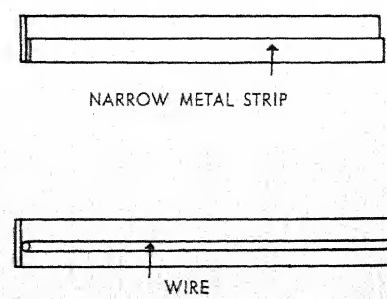


Figure 6



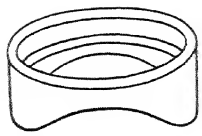
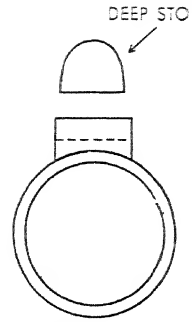


Figure 8



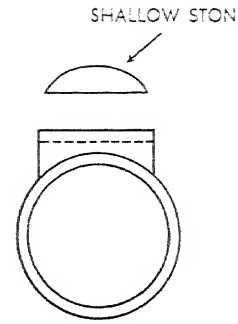


Figure 9

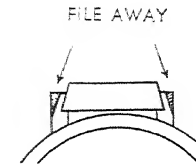


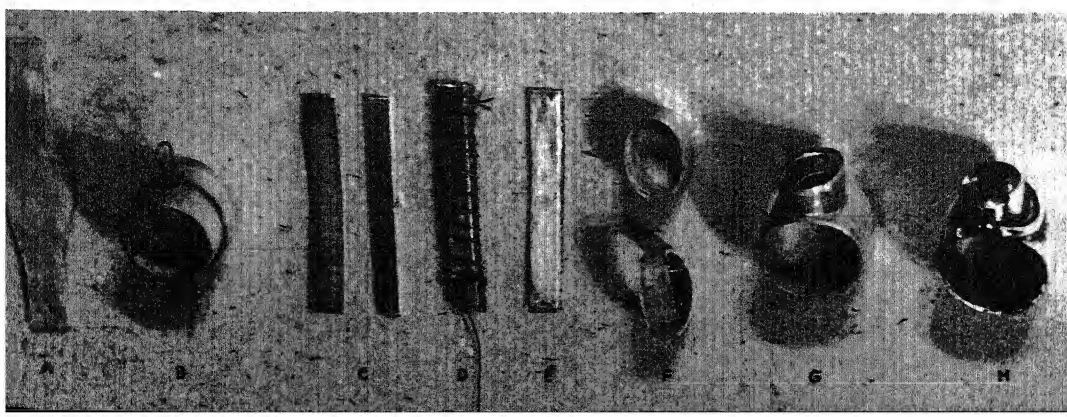
Figure 10

For transparent and translucent stones the ring is sometimes opened under the stone. A hole is drilled and an opening slightly smaller than the bezel sawed out (Figure 7B). Most rings of this type have a decoration appliquéd on the sides, either in wire or plate. Modern designers, however, do not as a rule add decoration to the ring shank because they prefer simplicity, and feel that the quality of the stone and the metal are themselves sufficient decoration (Figure 19). If the design demands it, wire or plate can be appliquéd, but it should conform to the character of the ring and seek to strengthen the design (Figures 7H and 16D). These bits of wire or plate should be scraped or filed and the same done to the ring. They may be held in place by U-shaped binding wires while being soldered.

Pickle the piece, finish filing, and smooth edges with emery cloth and emery paper. Examine the shoulder and remove any roughness on the inside of the bezel with riffle files or gravers. File away, on an angle, about one-third of the thickness of the bezel on the outside (Figure 10). This gives a better finish and makes the setting of the stone easier. At this stage the ring may be almost completely polished (see pages 92 and 93).

To set the stone, place the ring on a wooden mandrel or in the ring clamp. Using a pusher, press with a slow motion against the bezel. Start at the base and lift the hand up slightly to press down the upper part of the bezel (Figure 11). Don't try to get the bezel all the way down on the first time around. Move the ring around and push at opposite sides. This insures keeping the stone centrally placed in the bezel. For the order of pushing see Figure 12. After this operation the pusher may be carried around the bezel in a continuous direction, then with the curved burnisher held tightly in the hand and perpendicular to the stone, rub the bezel to a smooth polish.

Figure 7 Steps in making a ring with a cabochon stone. A—Ring blank; B—Blank shaped and soldered; C—Bezel with shoulder to hold stone; D—Bezel and shoulder bound for soldering; E—Bezel and shoulder soldered; F—Bezel shaped and soldered with stone fitted; G—Bezel soldered onto ring; H—Finished ring with stone.



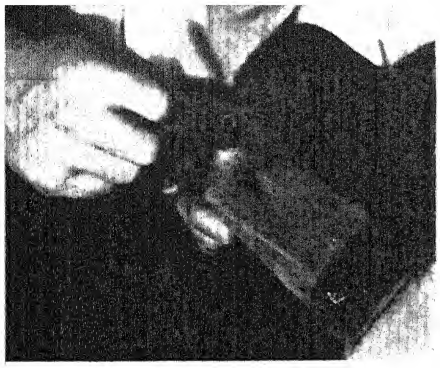


Figure 11

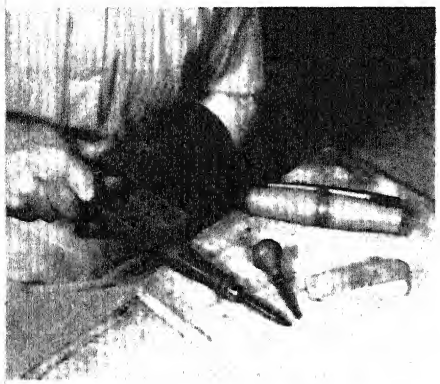


Figure 13

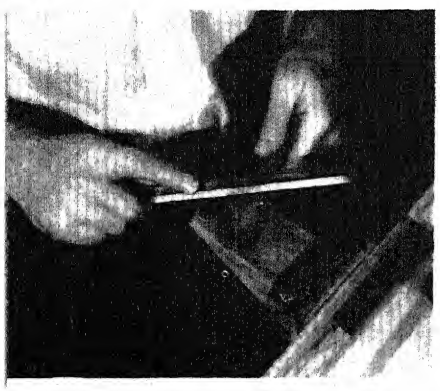
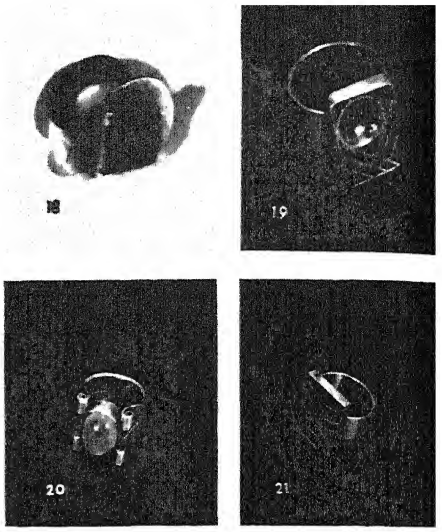


Figure 14



Figures 18-21 Rings by veterans.

The convex side of the burnisher is held against the bezel (Figure 13). Smooth away any irregularities with a fine needle file and burnish again. Finish the ring by oxidizing, if desired, and polishing (Figure 14).

Box Bezel A rounded or cabochon stone can be set in a box bezel if a table construction is used. This is a flat metal plate on which the stone rests. The shank meets the plate at points convenient to the finger. The length of the shank must be determined by subtracting the amount of space allowed for the end of the shank meeting the table (Figures 15 and 18).

Figure 12

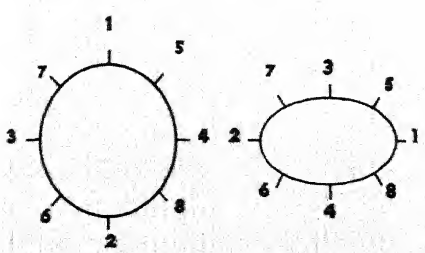


Figure 15

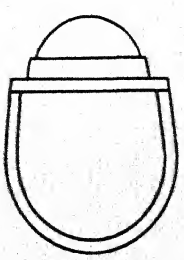
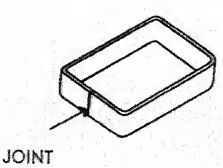


Figure 17



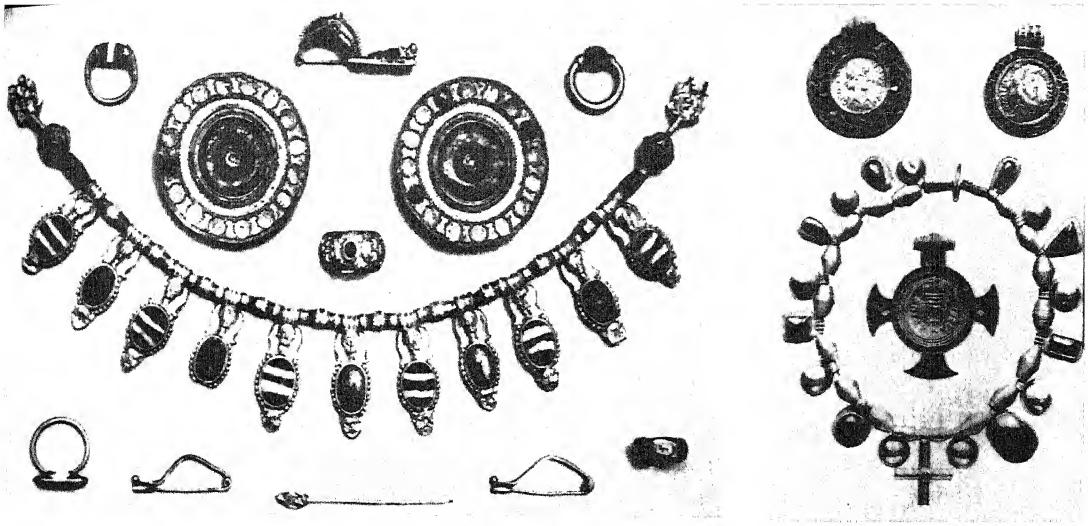


Figure 22 Etruscan jewelry. Photo from Metropolitan Museum of Art, *Handbook of the Etruscan Collection*, by Gisela M. A. Richter, Marchbanks Press, 1940.

Possible Variations in Design and Construction This project has introduced the simplest method of making a ring with a ring blank as a foundation. Even this blank can be varied by altering its shape or employing one of the processes learned in the other projects (Figure 20). For example, it can be pierced or etched, or even enameled. In some cases the beginner may not wish to use a stone (Figure 21). Effective rings can also be made without stones by appliquéing domes or pieces of metal in their place.

Rectangular, octagonal, or triangular stones can be set without a shoulder bezel. Often the bezel box can be included as part of the ring blank (Figure 16). When the bezel is made separately it must be soldered to the base or table. Rectangular, square, and triangular stones are harder to set than round or oval ones because of the difficulty of pushing down the bezel at the sharp corners. To overcome the difficulty in some degree, it is recommended that fine silver (pure silver) be used in making the bezel because it is softer and more ductile than sterling silver. Make the joint on one of the short sides (Figure 17). In setting stones of this type, the corners of the bezel should be pushed down first.

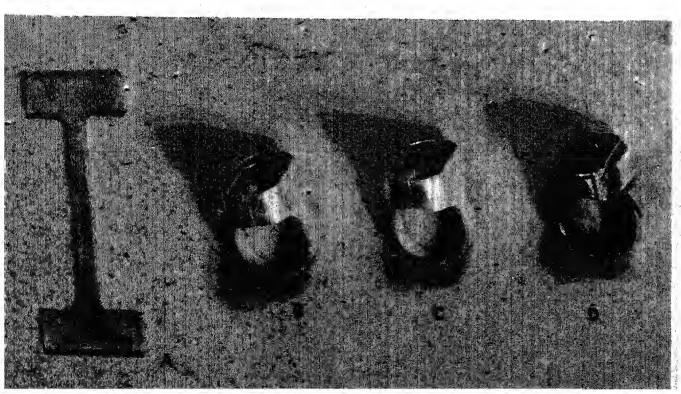


Figure 23 (above, right) Anglo-Saxon and Viking jewelry from England. Photo from *A Guide to Anglo-Saxon and Foreign Teutonic Antiquities*. British Museum, London, 1923.

Figure 16 Bezel as part of ring blank. A—Ring blank with bezel included; B—Ring blank shaped for octagonal stone; C—Ring blank soldered; D—Finished ring with stone.

PROJECT XIII: ENAMELING ON COPPER—LIMOGES

Decorative Pins in Color

Materials: 1 oz. colorless transparent enamel (flux), 1 oz. opaque white enamel, 1 oz. each transparent red and blue enamel; 2 pieces 16 gauge sheet copper, 2½" x 1¾" and 4" x 1"; catch and joint for soft solder; pin tong

Tools and Supplies: steel anvil; carpenter's hammer; agate or porcelain mortar and pestle; metal snips; medium half-round file; small brush; spatula; blowtorch or Bunsen burner; Bunsen burner tripod and wire screen; blowpipe; scraper; soldering tweezers; copper tongs; wrapping paper; #3/0 emery cloth; #3/0 emery paper; nitric acid; 2 glass or hard rubber developing trays 8" x 10"; glass graduate; 2 large sheets white paper; 2 small blotters; bowl; covered jars for enamels; soft solder; soft solder paste (flux); asbestos block

Enameling is the name given to a method of decorating metal by fusing onto it a kind of glass made in different colors. The enamel is spread on the metal in powder form and then fused by means of heat. There are two kinds of enamel: transparent and opaque. Colored enamels are made by adding different minerals and oxides of metals to colorless glass. The addition of coloring materials to the glass raises its melting point to varying degrees.

The worker should make a rough classification of the enamels which he plans to use as to high, medium, and low-firing colors. Enamels with extremely varying melting temperatures should not be used in the same piece. There are five well-known types of enameling which have been produced by craftsmen since the Middle Ages, they are: Limoges, champlevé, cloisonné, plique à jour, and basse taille. "Type" refers to the manner in which the enamel is applied, the enamels are the same in all types.

Limoges Type—opaque, transparent, mixed For the project described here, the Limoges type is chosen because it requires only simple equipment and very little preparation of the metal. The project may be executed in all-opaque, all-transparent, or a mixture of both types of enamel. If transparent enamels are chosen, it is necessary to first give the metal a coating of colorless transparent enamel called flux. This coating of flux is needed to preserve the brilliancy of the colored transparent enamels which are applied when the flux coating has cooled. Over the flux coating, transparent or opaque enamels, or both kinds, may be laid and the piece given a second firing. If necessary a third and fourth application and firing of enamels may be made. However, too many firings tend to result in a dulling of the colors.

If the project is to be executed in opaque enamels all the colors and the background color, if any, may be applied at once and given one firing. This method results in somewhat blurred edges on the different color areas or spots. If sharper edges are desired, a background of any opaque color, including white or black, should first be applied and fired. When this coating has cooled, other colors are added as called for in the design and the piece is given a second firing. Some designs may require more subsequent applications and firings.

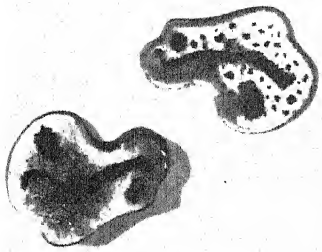


Figure 1

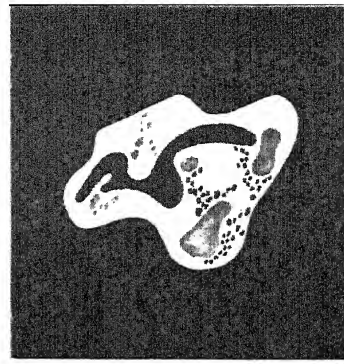


Figure 2

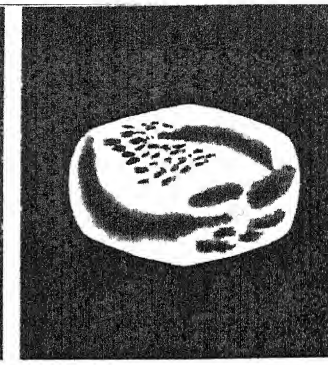


Figure 3

Transparent enamel, or both transparent and opaque enamels, may be applied and fired over a first coating of opaque white enamel. As in the case of transparent enamels over a first coat of flux, the white opaque background gives full brilliancy to the colored transparent enamels which are later applied.

The effect resulting from Limoges type of applying enamel is soft blurred contours, melting into adjacent areas or the background (Figure 1). While it is possible to achieve sharply defined areas in this type of enameling, it is probably better to take advantage of its tendency to blur and use this as a characteristic of the design. The beginner may, however, be disappointed if he expects clear edges, for at best he may get a ragged edge (Figure 1). If he wishes a precise edge, he should use the champlevé type explained in Project XIV.

DESIGN For this project a design may either be made beforehand or developed spontaneously, created directly with the enamels as the work progresses. If the worker prefers to have a prepared design before him, he is advised to make a sample using artist's water colors on a somewhat blotter-like paper. Newsprint will do very well, but if this is not available the soft-edge effect may be obtained by first dampening the surface of any ordinary drawing or water-color paper with a wet cloth, then painting in the different colors while the paper remains damp (Figure 3). In designing, try for variety of shape and size in the different color areas. The design should be of a very free and spontaneous nature (Figures 1 and 3).

PROCEDURE Grinding the Enamels Enamels are generally in lump form when purchased. In order to use the enamel, the lumps must be reduced to powder form. The large lumps may be broken by wrapping them in several thicknesses of heavy wrapping paper, laying the package on a steel anvil, and beating it with a carpenter's hammer. Do not use a planishing hammer or any smooth-faced hammer, the surface of which might be marred by the sharp edges of the enamel. Continue hammering until the pieces are smaller than the size of a pea.

Place about one-half the quantity of broken enamel (or ½ oz.) in an agate or porcelain mortar, cover with water, and crush the lumps by pressing downward upon them with the pestle (Figure 5). When the lumps are small enough to grind, work the pestle with a kind of circular and rolling motion. Continue grinding until the granules are about the size of salt grains. When the grinding is finished, the powdered enamel must be washed to remove the very small grains. Wash it by pouring water into the mortar, at the same time stirring up the powder with the fingers. Pour off the milky water and repeat the operation about six times, or until the water is clear. Pour off all surplus water and transfer the enamel to a clean glass jar which has a screw cover and label it with the color of the enamel. Repeat the above operation for all enamels to be used. They are now ready to be applied to the metal.

Preparing the Metal If the outer contour of the pin is simple, the copper sheet may be cut to size and shape with metal snips. If the contour is complex, it will be necessary to cut it with the

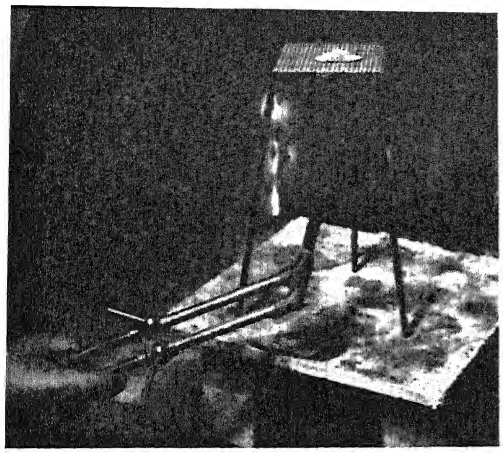


Figure 4

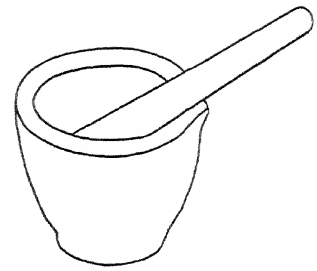


Figure 5

Figure 6

jeweler's saw. File the edges and smooth with #3/0 emery cloth and #3/0 emery paper.

The surface of the copper must now be cleaned. Enamel will not adhere to metal which is not absolutely free of foreign matter. Copper is cleaned by immersing it for a few seconds in a solution made of equal parts of nitric acid and water. Pour 2 or 3 oz. of water into a developing tray and then, very slowly, pour an equal quantity of nitric acid into the water. The mixing of acid and water generates heat. Allow the solution to remain in the tray for about 15 minutes, or until it is cool, then transfer it to the graduate. Holding the pin by one end with copper tongs, dip it into the acid, completely submerging it. After holding the copper in the acid for about 5 seconds, remove it and place it in a bowl or tray of water, leaving it in the water until it is time to apply the enamels in order to prevent oxidation of the surface. Take care not to get acid on skin or clothes (see page 22).

Preparing the Work Table When ready to apply enamel to the copper, prepare the work table by spreading a large sheet of clean white paper upon it. The following articles and tools should be placed on the paper: two small blotters, the ground enamels in jars, a small brush, a copper or brass spatula (which can be made by flattening one end of a piece of heavy 8 or 10 gauge wire), a bowl of clean water, and the copper pin blank covered with water.

Add enough water to each jar of enamel to bring the powdered enamel to the consistency of paste. Stir each color with the spatula, but be sure to clean it between each stirring—one small foreign grain of enamel might ruin an area. Remove the blank from the water with copper tongs, place it on a clean blotter, and with another blotter remove the surface water. Do not allow the fingers to touch the metal.

Applying Enamels If the purity of the colored enamels is to be retained it is necessary to first lay a background of transparent enamel (flux). When this is cool the various areas of the design may be filled in with the transparent enamels as planned. A variation of this procedure which results in still more brilliant color is to lay a first ground of opaque white enamel. When this has been fired and allowed to cool, the several colored enamels may be laid on as in the type described above. Still another variation is to have a ground that is partly transparent and partly opaque, the relative quantities of opaque and transparent being arranged according to the planned design. When the ground enamel is cool the other colors are added and fired as in the types described above. Using the spatula, spread the flux, in its paste form, uniformly over the whole piece of copper. The coat should be approximately 1/16" thick, or thinner if possible. If the enamel coating is too thick, it will crack off in chips when cool due to the difference in the degree of contraction be-

tween metal and enamel. Before attempting to melt the enamel, dry it thoroughly in a warm oven or on a radiator. Cover the pin with an inverted glass or pottery bowl to prevent particles of dirt or dust from falling on the enamel during the drying.

Testing the Enamels Before the color scheme for the project can be definitely fixed, the enamels tentatively chosen must be tested for their firing temperatures. You are reminded that it is not advisable to use, in the same piece, enamels which have extremely different melting points because the low-firing enamels melt and spread too freely before the high-firing colors have melted.

To test the enamels for melting temperatures, use a piece of 16 gauge copper, 4" x 1". Clean the copper strip as described in the section on PREPARING THE METAL. Then, using a spatula, lay out the four or five enamels to be tested, in separate spots about the size of a dime. Set the piece aside to dry before melting them. When the enamel is dry, place the copper strip on the wire screen mounted on a Bunsen burner tripod, common equipment in chemists' laboratories. If a blowtorch or a Bunsen burner is used, the flame must be directed upward from below the piece so as not to touch the enamel. The flame should be moved back and forth slowly under the copper strip in order to heat it evenly throughout its length. The copper will turn a dull red color before the enamel begins to melt. At this stage the worker should watch carefully to see which color melts first, or to see in what order the different colors melt. If an assistant is on hand he should record the results of the test immediately.

If the test reveals that one or more colors are slow to melt, a new test strip should be made substituting different enamels for those which showed high melting points. The aim of the test is to find four or five enamels which melt at relatively equal temperatures.

Fusing or Melting the Enamel There are various ways of melting the enamel which has been applied to the plate. The ideal method is to use an electric furnace. A gas enameling furnace can also be used. For this simple project, a Bunsen burner or blowtorch will suffice. A tripod with a screen over it is used as in the testing.

When the applied coat of enamel is thoroughly dry, place the pin on the wire screen and carry it to the tripod, avoiding jarring or shaking. Light the Bunsen burner and place it so that the flame strikes the center of the pin (Figure 4). When the copper becomes dull red the grains next to the metal surface will begin to melt. Leave the pin over the flame until the surface of the enamel is smooth and shiny, then remove the flame and leave the pin on the tripod until it is thoroughly cool. Slow cooling has an annealing effect on the enamel, and thereby reduces its brittleness.

In order to save added firings several colors may be put on at the same time, as long as they are applied in separate or juxtaposed areas—not overlaid. Interesting spotting effects may be produced by dropping on bits of enamel that are about the size of a pinhead. They may be crowded closely in one section and faded off to a few scattered dots in another section (Figure 1). It is advisable to save out a few bits of enamel of this size during the first stages of the grinding. When the last firing is done the enamel is completed. It should show a fairly smooth, completely glazed or fused surface (Figure 1).

Soldering on the Catch and Joint The catch and joint for the pin should be soldered on with lead solder (see pages 50-51). Lead, or soft solder, melts at a very low temperature, and is, therefore used instead of hard solder, because the low temperature needed for soldering does not affect the enamel on the other side of the pin. The catch and joint for soft solder are especially designed to be used with this kind of solder. They differ from hard solder joints and catches in one respect: attached to each one is an inverted saucer-like platform (Figure 6), like that on the ear wires described in Project XI, which gives more bearing surface at the soldered part to compensate for the fact that soft solder is not as strong as hard solder.

PROJECT XIV: ENAMELING ON COPPER—CHAMPLEVÉ

Belt Buckle or Pin Decorated with Color

Materials: **colored opaque enamels, about 1 oz. each of white, red, blue, yellow, black; 16 gauge sheet copper, about 2" x 2½" for pin, 1" x 3" for man's belt buckle; catch and joint for soft solder; pin tong, if a pin is to be made**

Tools and Supplies: **agate or porcelain mortar and pestle; carpenter's hammer; steel anvil; 1 square-end graver, about 3/32" across and 1 half-round-end graver, about 1/16" thick, if engraving process is used; water-color brushes; #2 camel's hair brush; copper spatula; tweezers; blowtorch or Bunsen burner; carborundum stones made especially for grinding enamel surfaces, ¾" x ¾" x 8", one coarse, one fine; copper tongs; charcoal block; asbestos block; pumice; carbon paper; resist varnish; 2 developing trays; graduate; nitric acid; soft string; benzine (or benzole); blotter; wrapping paper; 2 pieces clean white paper; water colors; large tin; large pan; pickle pan; soft solder; soft solder paste (flux); stiff brush; cloth**

Tools and Supplies for Pickling and Polishing in addition to those above **(see pages 91 and 92)**

In Project XIII you learned how to do enameling of the Limoges type. That to be employed here is champlevé, meaning "raised field." In this type, the enamel is set into depressed areas, or "lakes," etched or cut into the metal (Figure 1). The depth of the depressions may range from one-quarter to one-third the thickness of the copper. One color of enamel may be used in all the areas, or the colors may be varied in the different depressions. The areas may be recessed by etching them out with acid or by cutting them with engraving tools. Etching is easier, but either process may be used.

If you are making a belt buckle you will need to make a blank for it. There are many kinds of buckles, but we suggest the simple hook kind (Figure 2). You can devise one of your own. It is advisable to bend the buckle to shape before it is enameled.

DESIGN Since in champlevé enameling areas or spots of different colored enamels are used, trial designs may be made with water colors and a brush on paper. Values of white and black ink may be used also, the choice of colors being left until later. The color scheme is limited by the en-

Figure 1

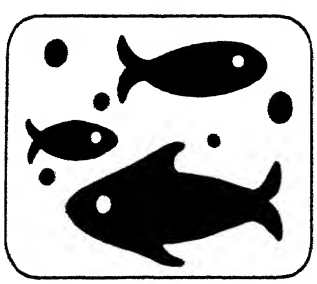
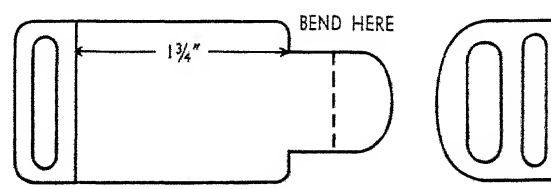


Figure 2



BLANK

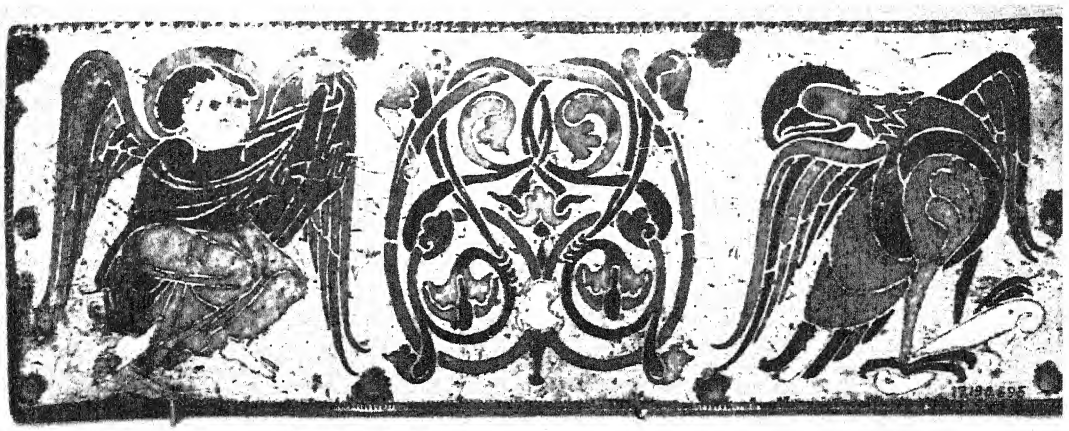
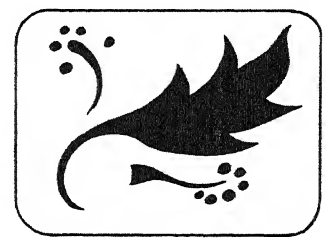


Figure 10 Spanish enamel plaque from a chasse, XII century. Photo from the Metropolitan Museum of Art.

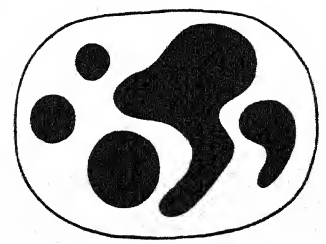
amels on hand. Design with the brush freely and spontaneously when making the trial designs. When one that is satisfactory has been produced, it may be drawn up more precisely and carefully. Avoid shapes with sharp points, and do not use lines of enamel less than 1/16″ in width. Enamel does not flow easily into sharp points or narrow channels. Figure 3A is not a good design for champlevé enameling for this reason. Organic or bold geometric shapes are ideal (Figures 3B and 4).

PROCEDURE If you plan to etch out the areas to receive the enamel, follow the directions in Project III, pages 21-23. The other method for making the depressions is cutting them out with engraving tools, also known as "gravers." Only two shapes are required, one having a square end, about 3/32″ across, and one with a half-round end, about 1/16″ thick (Figure 5). The

Figure 3



A—



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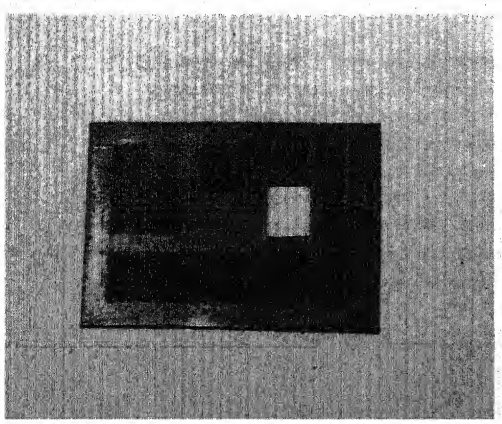


Figure 4

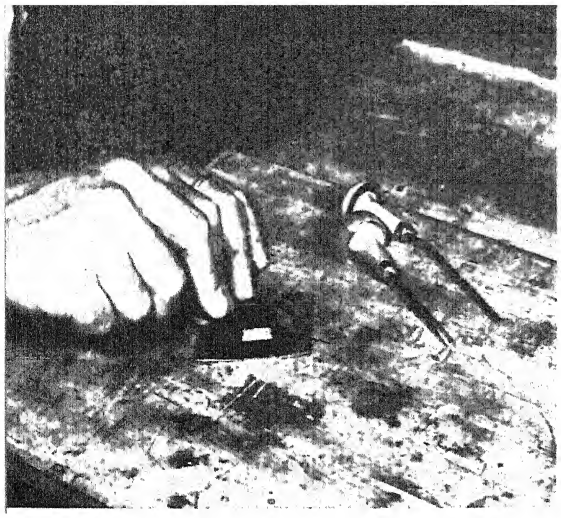


Figure 6

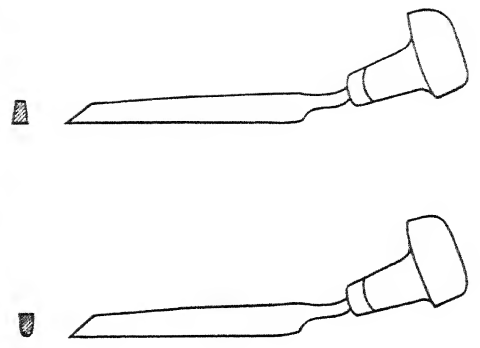


Figure 5

square tool is used to remove most of the metal; the round tool to smooth the edges of the depressions after the metal has been removed.

The square tool is used with what is known as a "wriggle cut," that is, the tool is made to "walk" across the metal by rotating the hand which holds it from side to side. The handle of the graver is placed in the palm of the hand and the thumb and forefinger are placed close to the cutting edge (Figures 6 and 7). The copper blank is placed on the bench and held firmly by the left hand at the section nearest the worker, that is, behind the cutting edge of the graver. Holding the plate with the left hand in front of the graver is dangerous because of the possibility of the tool slipping. The inexperienced worker should practice the "wriggle cut" on a scrap of copper before attempting to cut the final piece. The "wriggle cut" produces a mark like that in Figure 8.

When you have a design prepared, transfer it to the copper plate with carbon paper. Using the square graver, begin cutting the design areas just inside the outline. Go over each area first with the cuts in one general direction, then turn the piece around and make a second series of cuts at right angles to the first cuts. Continue making alternating cuts at right angles until the desired depth has been obtained. The depth of the depression should be approximately one-third the thickness of the metal.

The edges must now be made smooth by using the half-round graver with a pushing stroke. This cut requires more control and skill than does the "wriggle cut," and should be practiced before attempting the final cut. The round graver is held in the hand in the same way as the square one. The stroke is made by holding the graver as shown in Figures 6 and 7, and pushing the graver firmly forward in a continuous line, making many cuts until the edge of the depression is smooth. The left hand must be kept back of the tool, as there is more danger of its slipping than with the square graver. After the depressions are cut and their edges smooth, the piece may be laid aside until ready for cleaning in the acid dip.

It is most important that the copper which is to receive the enamels be made absolutely clean and that no oxidation of its surface be allowed to take place. For this reason the cleaning of the copper should be deferred until all preparations for applying the enamel are completed. The arrangement of the materials and tools and the cleaning of the copper are explained in Project XIII, pages 61 and 62.

The ground enamels should have just enough water in them to hold the particles together in a paste-like consistency. Using a spatula (see page 62 for making it), pack enough enamel into each area to bring the top level of the enamel about 1/16" above the top surface of the copper. The extra thickness of the enamel layer is to allow for its shrinkage when fired. Try to make the layer of enamel uniform in thickness.

Figure 8

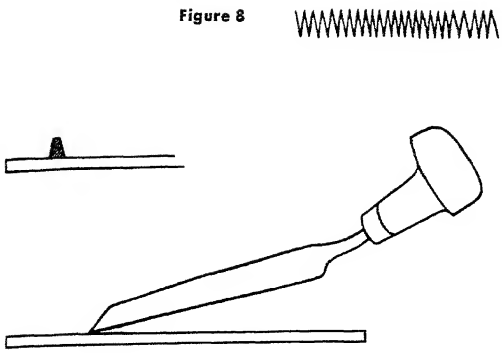


Figure 7

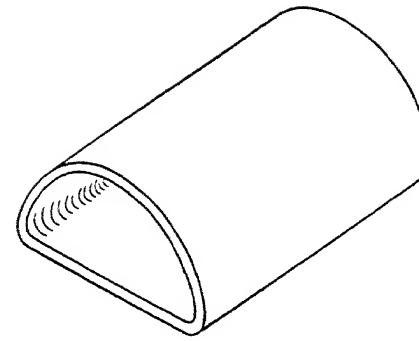


Figure 9

When all areas have been filled with enamel, the piece should be put aside to dry. At ordinary room temperature, drying may take several hours, but it may be hastened by placing the piece in a kitchen gas oven, set at a temperature of about 300° F. To prevent dust particles from settling on the enamel, the piece may be covered with a transparent glass bowl or tumbler propped up in such a way as to allow for the circulation of air in it.

The best way to melt the enamel is in a gas or electric furnace made especially for the purpose. A small electric pottery kiln is excellent also. The gas or electric enameling furnace consists of the heating element or unit and a separate chamber made of vitrified fire clay in which the piece to be enameled is placed. The chamber is usually made in one piece in the form of a half-cylinder, with one opening only, placed at the front (Figure 9). When cracked or broken, the chamber may be replaced. A door on the main body of the furnace closes the front opening while the kiln is in operation.

If the furnace or kiln is not available, the enamel may be melted with a blowtorch or a Bunsen burner as explained in Project XIII. The work should be done in a room free from draughts of cool air. Hold the blowtorch or Bunsen burner as shown in Figure 4, page 62. When using the flame, it is important not to allow it to touch the enamel. After melting the enamel, the whole set-up, including the screen with tripod if necessary, should be covered with an inverted clean tin, previously chosen for ample size. Covering the enamel after melting prevents the cool air from striking it.

When the enameled piece is thoroughly cool, examine it for bubbles and hollows. It is very rarely that enamels come out of the fire without flaws. Pin holes and bubbles are cleaned out with any sharply pointed tool. High spots are removed by grinding off the whole surface, including the copper, with water, and a carborundum stone made especially for the purpose. The carborundum leaves the copper in a rough state with deep scratches. These should be removed by a final grinding over the whole surface with a fine-grain carborundum stone, after which all foreign particles should be washed off by brushing the piece thoroughly under running water. Allow it to dry and fill in any hollows with enamel. The enamel must be dried and fired in exactly the same way as for the first firing. If all goes well, the enamel is finished after the second firing. Pickle the piece and wash it with a brush under running water, file the edges and polish (see pages 91-93).

If a pin is made the catch and joint should be attached with soft (lead) solder, because the temperature required for hard soldering might crack or otherwise injure the enamel (see pages 50, 51 and 63). Polish and finish the piece after the soldering. Enameling can also be effectively applied to other kinds of jewelry such as bracelets and necklaces.

PROJECT XV: RINGS WITH PRONG SETTINGS

Simple and Advanced Types

PROCEDURE A: SIMPLE PRONG SETTING: For Cabochon or Rectangular Stones

Materials: 16 gauge sheet silver 1" x 1"; wire for prongs; cabochon or rectangular cut stone

Tools and Supplies: jeweler's saw frame; #2/0 saw blades; side-cutting nippers; set of needle files; medium-cut file; ring clamp; pliers; pusher; hand buff; curved steel burnisher; #3/0 emery cloth; #3/0 emery paper

PROCEDURE B: ADVANCED TYPE OF PRONG SETTING: For Faceted Stones

Materials: 16 gauge sheet silver, 2" x 1"; 22 gauge sheet silver, 2½" x ¾"; round faceted-cut semi-precious stone

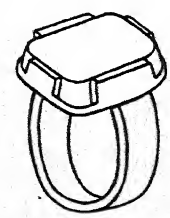
Tools and Supplies: the following will be needed in addition to the tools indicated for the simple prong setting: ring gauge; lead block; dapping tool; ring mandrel; chain pliers; mallet or hammer; center punch; nail set; hand drill; #30 twist drill; ⅜" dowel

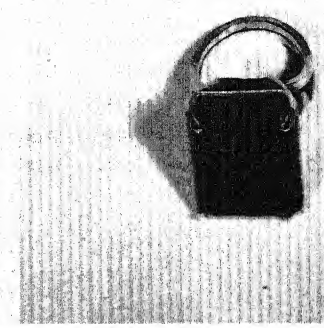
Stones can be set with prongs instead of a bezel. Three or more prongs effectively spaced hold the stone in place—such a construction is a prong setting. This type of setting allows for more variation and ingenuity than the bezel type, and is preferred for transparent gems because the prongs expose more of the stone to the light than the closed band or bezel types of setting, increasing the amount of light refraction within the gem so that there is an intensification of color and "fire." It is used primarily for transparent stones, those with faceted surfaces such as amethysts, diamonds, topazes, emeralds (Figure 1).

While the prong setting for stones with faceted surfaces is quite advanced and requires considerable skill, there are simple variations which can be used with cabochon or rectangular stones. These will be discussed first (Figures 7 and 23).

Figure 1

Figure 7





PROCEDURE A A base is first made for the stone. This is a simple plate the size of the stone, sawed out of 16 gauge silver and finished. Prongs are soldered at intervals, fastened under the plate, rolled over the edge, and pushed against the stone (Figure 2). If the plate is thick enough and the prongs are wide they may be soldered to the edge (Figure 3), but this construction presents the problem of holding the prongs in place while soldering them. A convenient solution is to drive pins against the base plate and into the charcoal block to hold it, and to drive one or more pins against the prong (Figure 4). The number of prongs will depend on the shape of the stone and the effect of the design. A round stone can have a minimum of three, while a rectangular stone needs four.

For soldered prongs a round, half-round, or flat wire of the proper gauge should be used. Take care to have the prongs long enough to hold the stone securely (Figure 5). In the case of transparent stones, a hole should be cut out of the plate to allow the light to come through (Figure 6). The base can also be made of wire and the prongs soldered to it.

This type of setting can be used on stones set in any kind of jewelry: rings, pendants, bracelets, chokers. Sometimes the prongs can be wide like a broken or partial bezel (Figure 7). When to use the bezel or prong setting must be determined by the craftsman depending on which type best suits the particular stone and piece of jewelry under construction.

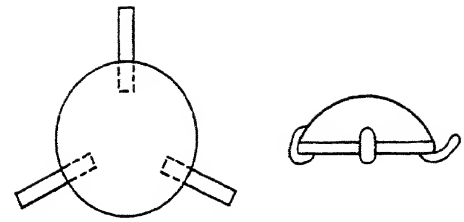


Figure 2

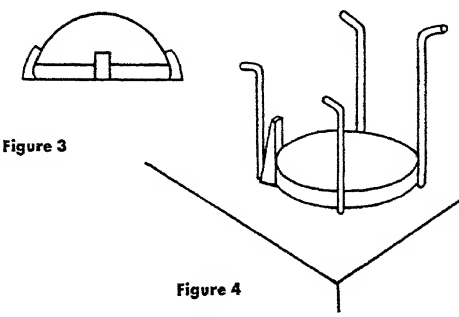


Figure 3

Figure 4

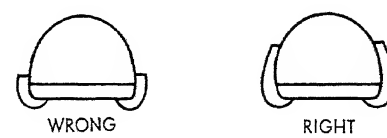


Figure 5

Figure 6

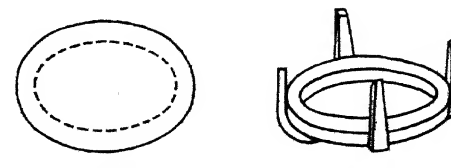


Figure 23 **Ring by a veteran.**

PROCEDURE B The first step in making a prong setting is the construction of a cup or truncated cone of silver with a shoulder or ledge near its top on which the stone rests. The prongs are later cut out of this cup. Because the circular setting is easiest to make, choose a stone which is circular in shape. There are many kinds of transparent, faceted stones, in the semi-precious category whose price may be more within the beginner's reach than the precious variety.

The pattern development of the setting, that is, the plotting of a shape in flat silver which will, when bent into form, produce the cup-shape desired, requires accurate planning and some elementary mechanical drawing. Since the cup of the setting is a truncated cone (Figure 8), it will be necessary to develop a cone in flat pattern on paper. Begin by drawing a profile view of the stone to actual scale, using a ruler and pencil; then draw the cup in such a way that the stone appears in position within it (Figure 9A). The vertical dimensions of the setting should be such that when the stone is resting on its shoulder, the base of the cup extends below the lowest point of the stone. Remember to indicate the thickness of the metal (16 gauge) which will be halved, of course, above the shoulder. Using a ruler, extend the lines forming the sides of the cup until they meet in a point C, in the illustration Figure 9A. With a compass, using the lengths C, Y, and C, N as radii, and the new point C, Figure 9B, as a center, describe two concentric arcs of indeterminate length. A length XY equal to the circumference of the top edge of the cup must now be laid out along the larger arc. There are two means of determining this length: one is to measure the diameter of the circle and multiply this length by the number π (Pi$=$3.1416). The product will be the length of XY, to be laid out along the curve of the larger arc.

Another method not requiring mathematical calculation is as follows: describe a circle having the same diameter as the top rim of the setting (Figure 9D). Draw vertical and horizontal lines, and using a 45° triangle, diagonal lines through its center. The circumference is now divided into eight equal parts (Figure 9D). Set a pair of dividers to the length of one of these divisions and mark off eight spaces along the larger arc of the pattern. When the lines CX and CY have been drawn, the completed pattern for the setting—the shape X, Y, N, M—will be seen (Figure 9B). Transfer the pattern to a piece of 16 gauge silver and cut it out with a jeweler's saw.

Before bending the silver into shape, the shoulder on which the stone is to rest must be made by filing a rabbet or groove along the convex top edge. First draw a pencil line parallel to the top edge and about ⅛" below it. Then using a square needle file, file away the band above this line until about half the thickness of the metal remains (Figure 9C). The filing will be made easier if the piece is bent slightly backward, so that the surface in which the groove is to be filed is slightly convex. After filing a right-angle groove, refine the shape of it by sloping the shoulder slightly to conform to the shape of the stone (Figure 9E). The shape may be further refined after it has been bent.

The two end edges will form the joint and must, therefore, be filed straight and even so that they will meet to make a tight butt joint. Use a flat needle file. The piece may be bent to shape with heavy round-nose pliers (Figure 9F). Begin bending at the ends and work toward the middle. After the bending has been completed to make a cup, the joint edges should be given a final filing, for which it may be necessary to open the joint slightly. Examine the joint by holding it in front of a strong light. When a perfect fit has been made, the joint can be soldered. Another way of making a close joint is to hold the sides together as tightly as possible with the fingers, making a saw cut at the joint with a #2/0 jeweler's saw.

The next stage in the making of a prong setting is laying out the shape of the prongs in pencil on the outer surface of the cup (Figure 9G). For this project it is recommended that the number of prongs be limited to six, their length determined somewhat by the size and cut of the stone. Draw a pencil line about half-way

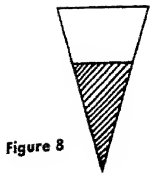
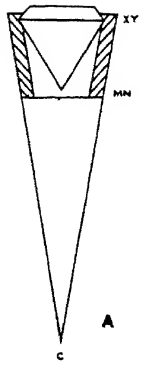
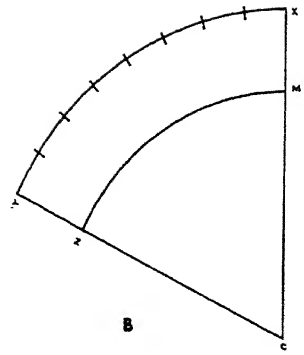


Figure 8





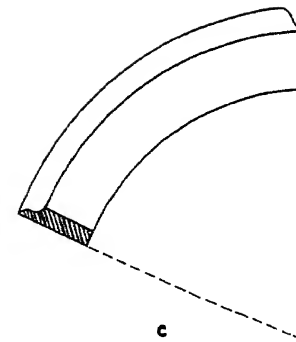
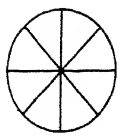
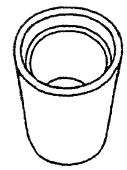


Figure 9





up the outer side of the cup. The line may be made by laying a pencil on a flat surface and turning the cup while pressing it against the pencil point (Figure 10). With a compass, describe a circle larger than the big end of the cup and lay off the radius of this circle around its own circumference, dividing it into six equal parts. Draw the radii to these points, then center the cup over this figure and mark it where the radii meet the edge of the silver (Figure 11). Extend these marks up to meet the pencil line on the cup so that the line is divided in six.

Force the cup onto a mandrel that tapers at approximately the same degree as the cup—experimenting with different mandrels until the best fit is achieved (Figure 12). A center punch or a nail set may be used as a mandrel. Holes must now be drilled through the setting at the six points already determined. Using a small sharp center punch, make an indentation in the silver at each division point. The indentation keeps the point of the drill in exact position at the beginning of the drilling. Use a hand drill and a #30 twist drill to make the holes. With a pencil, draw the shape of each prong, using the drilled holes to mark the valleys between each prong (Figure 13).

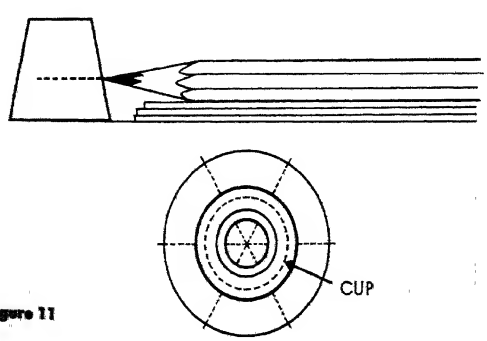


Figure 11

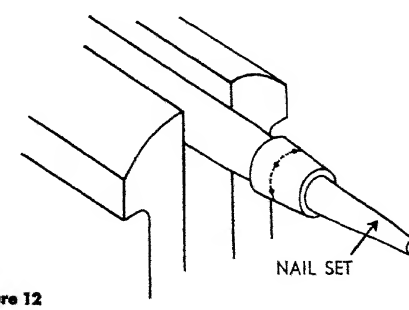


Figure 12

To saw out the sections of metal between the prongs, use a #2/0 jeweler's saw blade, sawing just outside the line to allow for filing. Some difficulty may be encountered in holding the setting while sawing. If the setting is small enough it may be held in a ring clamp, but if it is too large to fit into such a clamp, some other device may be invented for holding the setting during this operation. A dowel about 4" long, for instance, with its diameter approximately that of the inside diameter of the setting may be tapered and forced through the setting from the top (Figure 14).

After sawing out the prong shapes, use round and flat needle files to file each prong to an accurate shape. The side or profile view of each prong should be considered as well as the front view. The prongs have a more graceful appearance if tapered slightly in profile view, from base to top. To create this taper, file both the inside and outside of the prong (Figure 15A). Also file the outer side of the tip end of the prong to a rounded shape (Figure 15B). Round off the bottom edges of the setting with needle files and finish all edges with #3/0 emery paper wrapped around small wedge-shaped sticks of wood.

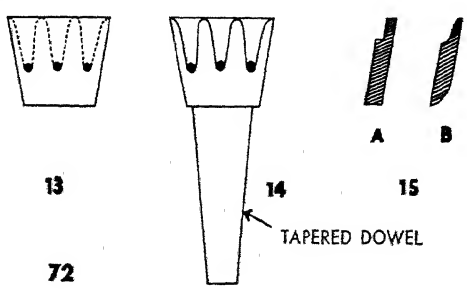
Test the setting for size by placing the stone on the shoulders of the prongs. If the fit is too tight, either file away a little of the shoulder on each prong or bend each prong outward very slightly with pliers. If the fit is too loose, bend each prong inward. The completed setting is shown in Figure 9H.

The shank of the ring should now be designed, giving special consideration to the form of the setting. Two types of shank are commonly used: in one the shank is narrower than the setting and is soldered to it on opposite sides (Figure 16A); in the other the top of the ring, at the stone, is wider than the setting (Figure 16B). The latter type is somewhat easier to make, due to the fact that the shank forms a complete circle, and the exact finger size can be more easily attained. For this project, the making of the latter type of shank will be explained.

The shape of the shank as seen from the side must also be considered. Because the setting is deep, the shank must be thick enough where it joins the setting to extend from the base of the setting to a point a little below the depth of the prong (Figure 17). To make the shank described above, begin by finding the ring size, using a ring gauge or wrapping a strip of paper around the finger. From a sheet of 22 gauge silver saw the ring blank (Figure 18). File the edges with a medium-cut file and smooth them by rubbing with #3/0 emery cloth and #3/0 emery paper. Anneal the blank and shape it on a lead block with a large dapping tool (Figure 19).

When shaped, the blank should resemble the section shown in Figure 20. During the shaping on the lead block, the blank will automatically become ring-shaped as well as hollowed in cross section. In order to shape the ends of the shank, it may be necessary to twist it temporarily by bending the ends sidewise away from each other

Figures 13, 14, and 15



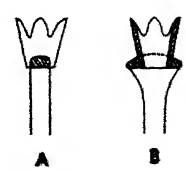
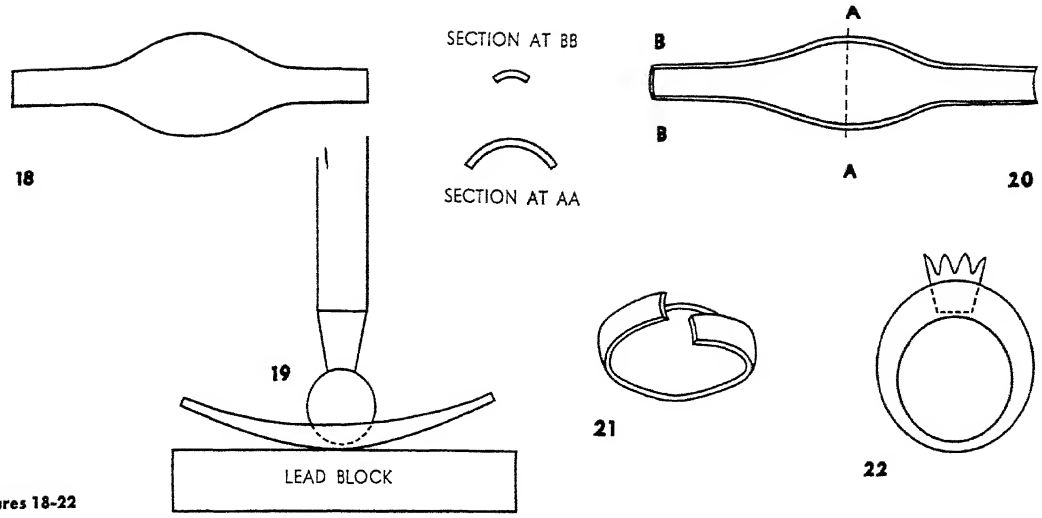


Figure 16

Figure 17



Figures 18-22

with the fingers (Figure 21). When the ring is shaped, force the ends of the shank together and test for size on a ring mandrel. Proceed with the binding and soldering of the joint as explained in Project VIII (pages 42 and 43).

The next step is the cutting of a hole in the top of the ring, in which the setting is to be soldered. Hold the setting in the center of the widest part of the ring and with a pencil or scriber trace the outline of its base on the ring. Drill a hole in the shank with a #30 twist drill and either saw or file out the opening to the size of the setting. Continue filing and testing until the setting rests in the opening at the proper height (Figure 22). Prepare the outer surface of the setting by filing it lightly at the section which is to be soldered. Flux both shank and setting and proceed with the soldering; no binding is needed.

Since this project is chiefly a problem in construction, the matter of decoration on the ring will not be discussed here. The reader is referred to Project VIII.

All edges should now be smoothed with emery cloth and paper, and if desired, the ring may be polished. If a motor buff is used in polishing, care must be taken not to wear away the points of the prongs. One must also be careful not to let the prongs catch in the felt or cloth buffing wheel. A hand buffing is recommended.

The stone can now be set. Use a ring clamp to hold the ring while setting the stone. Before placing the stone, partly bend the tops of three adjacent prongs toward the center with chain pliers. Place the stone on the shoulder, and with the pusher slowly bend the tops of the other three prongs over onto the stone. Do the pushing gradually, a little at a time, striving to keep all the prongs bent at an equal angle at each stage. When the tops of all prongs have been turned down over the stone, test the setting for tightness by trying to move the stone with the fingers. If it is not tight in its setting, it will be necessary to continue working with the pusher. The final step in turning over the prongs is to polish them by rubbing them with the curved steel burnisher. Ordinarily rings of this type are not oxidized. Give the ring a final polishing with a hand buff and polishing rouge.

PROJECT XVI: WIRE DRAWING

and Tube Making

Materials: 12 or 14 gauge copper wire, 12" long; 28 gauge sheet silver, 6" x ⅜"

Tools and Supplies: drawplate; files; bench vise; draw tongs; metal snips; riveting hammer; soap; block of wood

Tools and Supplies for Annealing and Soldering in addition to those above (see pages 88-89)

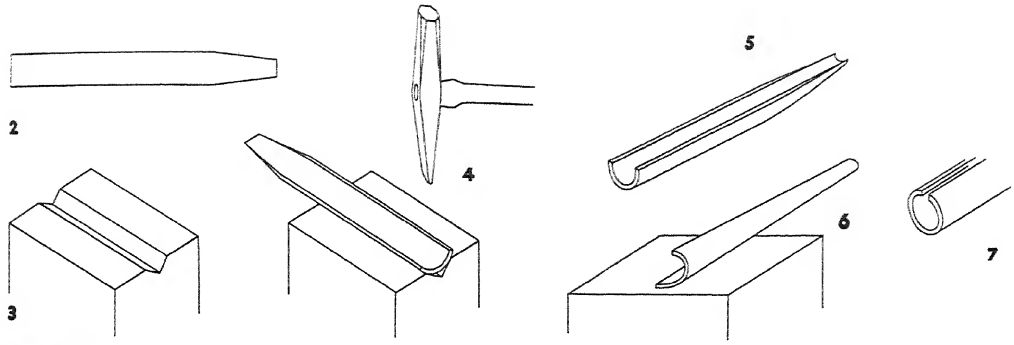
Knowing how to draw wire and to make tubing increases the range of both design and technique (Figure 9 and Figure 17B, page 85).

PROCEDURE Wire Drawing It is difficult, if not impossible, for the beginner to make his own wire, but a larger wire can be made smaller and changed in shape with the aid of a drawplate. The drawplate is a flat piece of steel about 5" x 1¾" x ¼", in which is a series of holes, accurately graduated from large to small. The holes are usually arranged in two rows (Figure 1), tapered from larger at the back to smaller at the front or face of the plate. In addition to round holes, drawplates are made for different shapes, as square, half-round, elliptical.

Anneal the wire to be drawn, and with a file shape one end to a point, small enough to allow it to project on the face about ⅜". Place the drawplate horizontally in a strong vise. The bench or table to which the vise is fastened must be bolted to the floor. The face of the drawplate should be at the front, that is on the side of the worker. Soap the wire with a moist cake of soap throughout its length, and push the point from the back of the plate through the hole which most nearly corresponds with its size. Grasp the projecting point with draw tongs and give a steady pull (Figure 1). Pull the wire all the way through without stopping during the pull. Resoap the wire; repeat the operation, using the next smallest hole. Do not skip any holes in the series until you have reached the size you want. If you draw the wire through more than three holes it will become hard and may break. A safe rule is to anneal after drawing through three holes. Anneal again before using.

Tube Making Tube making is similar to wire drawing. After the tube is roughly shaped by hand it is drawn through the drawplate in exactly the same way as wire is drawn. This operation reduces the diameter of the tube, and for this reason the first rough shape of the tube should be larger in diameter than the size required. The tube is started by cutting an annealed piece of 28 gauge silver about 5" long and about ⅜" wide. This will produce a tube about ⅛" in diameter. With metal snips cut one end as shown in Figure 2. The cut end corresponds to the pointed end of the wire in wire drawing. Cut a V-shaped groove in a block of wood, using either a coarse square file or a fine saw (Figure 3). Place the strip over the groove and begin the bending by using a riveting hammer (Figure 4). The strip will now be shaped as in Figure 5. Lay the strip on the flat side of the block of wood as in Figure 6. Use the other end of the same hammer and carefully tap the edges until they meet in the form of a rough tube. Make sure that the edges come together to form a butt joint (Figure 7). If it is difficult to rough-shape the tube as described, a metal rod may be pushed through it and the final tapping done with this support. The edges must not lap past each other. The tube is now in rough form with a taper at one end for entering the holes of the drawplate.

When the joint does not need soldering, for example, tubing for the hinge of a box, it is finished



Figures 2-7

by drawing it through the plate. Soap the tube before drawing it through the holes of the plate. If once through does not produce a good tight joint, try the next hole. Usually twice through is enough. Be sure to wash the tube clean if it is to be soldered to a box as a hinge or used in any other way where soldering is needed.

Soldering the Tube Some projects require that the joint of the tube be soldered, such as links (Figure 9), therefore the strip should be prepared for soldering before the rough shaping. File both edges to clean them and roughen them slightly. The roughness produced by the file results in a stronger joint. Rough-shape the tube as described above. Paint the joint with flux. The rough tube should now be drawn through one hole in the drawplate. Do not use soap; be sure the hole in the drawplate is free from any dirt on the joint which would interfere with soldering.

If once through does not produce a "good tight joint" draw the tube through the next smallest hole. Twice through the drawplate is ordinarily sufficient to close the joint, but if this does not do it, flux the joint heavily in order to keep it clean, anneal the tube, and draw it through again. When the joint is ready for soldering, lay the tube, joint side up, on a charcoal block, reflux the joint and place pellets of solder about ½" apart along it. Apply heat until the solder flows. Continue drawing through the drawplate until the desired diameter is obtained. Now that the joint is soldered, soap should be used each time before drawing for the final shaping. Anneal after every three holes.

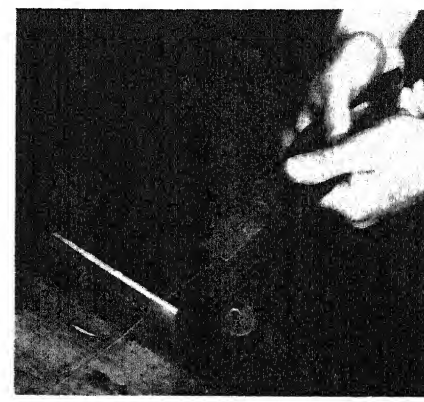


Figure 1

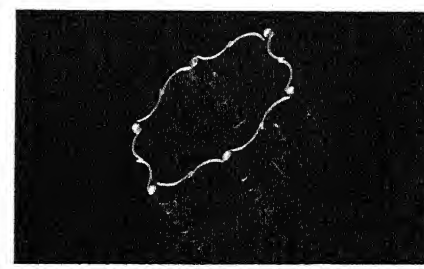


Figure 8
Bracelet by Adda Husted-Andersen.

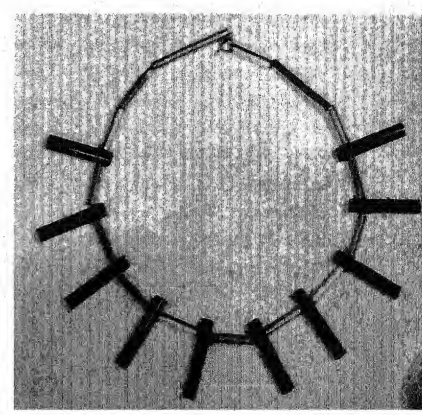


Figure 9
Necklace by Victor D'Amico.

PROJECT XVII: CHAIN MAKING

Simple and Decorative Chains

Material: 18 gauge round silver wire, about 32" long

Tools and Supplies: bench vise; mandrels, round and rectangular; saw frame; saw blades #2/0; rawhide mallet; two pairs of pliers; needle files; camel's hair brush; yellow ochre

Tools and Supplies for Annealing, Pickling, and Polishing in addition to those above (see pages 88, 91, and 92)

In planning a chain it is important to choose a gauge of wire that is in proportion to the length of the link to be made, in the interest of both good design and good structure. For example, a link ½" long requires a heavier gauge wire than one which is only ¼" long. The number of links required in a given length of chain may be determined accurately enough for practical purposes by the trial method. The shape of the link depends on the style of chain desired, which in turn depends on the pendant which it holds. One is usually safe, however, if he uses a simple chain. The links described here are the simplest to make, and after the beginner learns these he can design his own.

PROCEDURE Mandrels Links are made by winding wire on a mandrel, which is a round, oblong, or square tool about 3" or 4" long, made of steel or hard wood for shaping the links. Mandrels can be easily made from nails, dowels, or sticks; the shank of a tool such as a repoussé or dapping tool will serve the purpose (Figure 1).

Estimating Amount of Wire A few test links, enough to make an inch or two of chain, may be wound on the mandrel, cut open and linked together without soldering. When the number of links to the inch is known, multiply this by the length of the chain in inches. An average necklace is 14" long, but the actual length will depend on the size of the neck and whether you wish the chain to fit close to the neck or to hang low on the chest. It is advisable to coil a few extra links to allow for the possibility of burning some or for soldering failures. By straightening out one link and finding its length in inches or fractions of an inch, the total length of wire needed may be estimated.

Making a Chain of Round Links Anneal the wire before beginning. To avoid burning the wire, form it into a tight coil and bind with binding wire in three places. When coiling small round links, choose a round finishing nail of a diameter equal to the inner diameter of the link desired. Hold the nail vertically with one end between the vise jaws, and hold the silver wire against the nail at an angle. Grip the two together in the vise (Figure 2). Pull steadily on the wire and begin winding around the nail. Keep each coil in close contact with the preceding coil (Figure 3). Keep count of the number of turns in order to arrive at the required number of links. Now cut across the full length of the bound coils with a jeweler's saw. Use a #2/0 blade. The proper position in sawing is to grip the bound set of coils horizontally at the top of the vise. Protect the coil from scratches or marring by gripping heavy paper between the coil and the vise jaws. If the vise has soft copper jaws, no other protection is needed (Figure 4). Allow the end to project about ¾" and hold the saw blade parallel to the nail and tilted slightly down at the handle end. Do not try to cut through more than five or six links at a time. Catch the links in a box as they fall off the mandrel. When five or six links have been cut, saw off the projecting

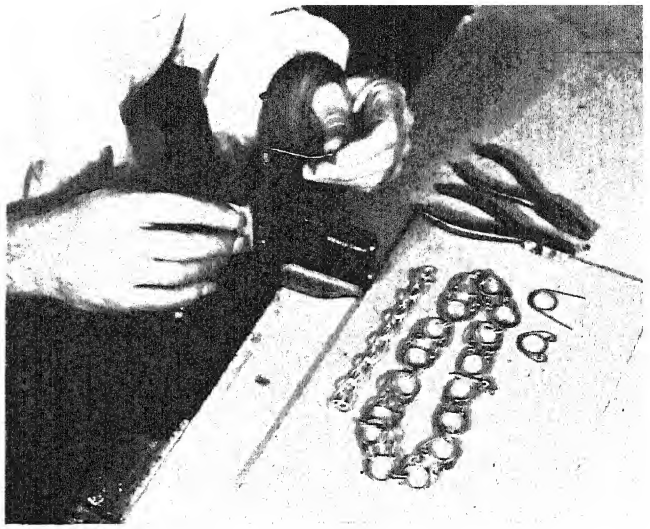


Figure 3

end of the nail, move the coil forward to allow the end to project from the vise, and proceed as before. If a tool is used you will, of course, not want to injure it, therefore merely slide the coil forward as you saw the links.

Making a Chain of Oval Links The coiling of oval-shaped links is the same as for round links except that the mandrel is rectangular in cross section instead of round (Figure 1C). Mandrels may be made of metal or wood, for example, strips of copper or aluminum, or hard wood such as maple and oak, as was mentioned above. The wood mandrel, however, should be used only for rather large links and only in case thick enough metal is not available. Added thickness may be achieved by folding the metal three or four times. The mandrel need not be shaped to an oval section. Wire coiled around a rectangular mandrel comes out as an oval due to the fact that in winding the wire around the mandrel it is not possible to make absolutely sharp bends. However, if rectangular links are desired, hammer the coiled links while still on the mandrel, with a rawhide mallet. Place the mandrel on a maple block while hammering, and hammer all sides. Make the mandrel about 3" long and slightly thinner and narrower than the desired inside dimensions of the link. Oval and rectangular links should be sawed in the middle of the narrow side (Figure 5).

Soldering Links Links may be soldered without filing the joints. However, to insure successful

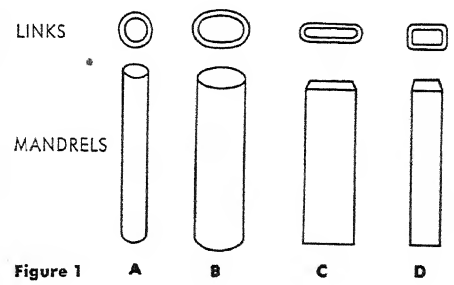


Figure 1

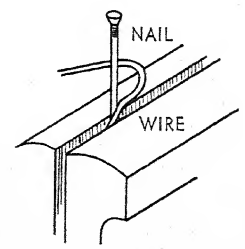


Figure 2

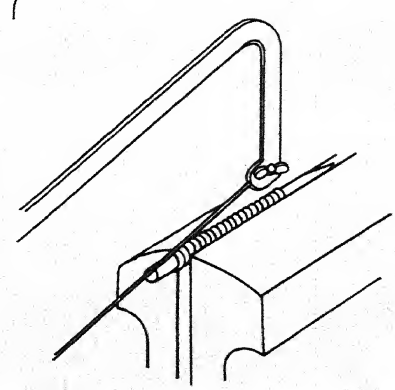


Figure 4

Figure 5

Figure 6

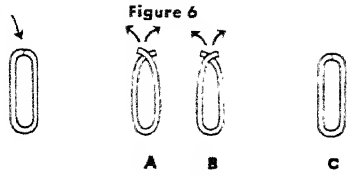


Figure 7

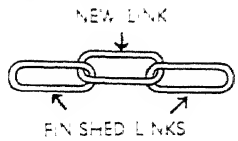
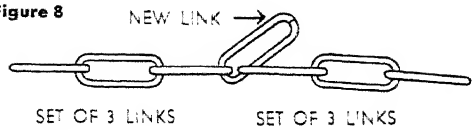


Figure 8



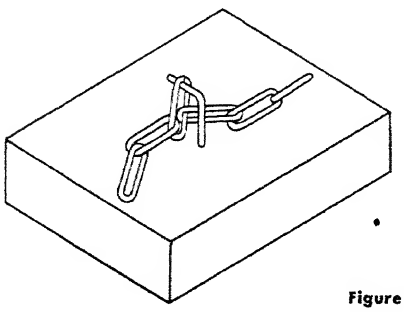


Figure 9

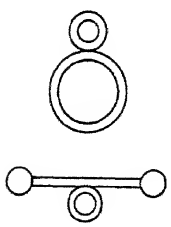


Figure 10

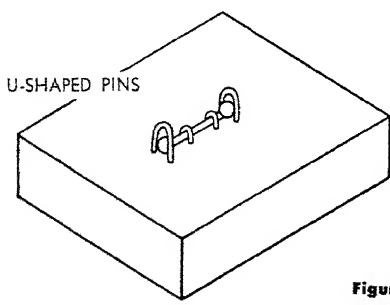


Figure 11

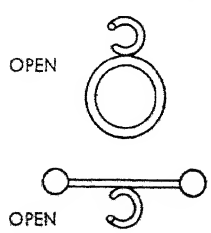


Figure 12

soldering, the two ends of the link should be brought together in such a way that they press gently against each other. This is done by bending each end in turn slightly past the other, using two pairs of pliers. First bend the ends past each other on one side (Figure 6A), then bend them back and past each other on the other side (Figure 6B), finally pull the ends back and place together as a butt joint (Figure 6C). This operation should be done very carefully in order to preserve the spring or tension in the link.

Soldering may be speeded by planning systematically. For example, in a chain consisting of 42 links, 24 should be soldered as single links. Make 24 links as explained above and lay them all out on the charcoal block. Paint each joint with flux and place one small pellet of solder on each joint. The pellets must be uniform in size. Use a small flame and after slowly drying the flux, proceed to apply the torch flame to each link in turn. Too large a flame will burn the links.

Join all the single links in sets of three, by joining two finished links with a new link (Figure 7). Bend each connecting link as described above and lay out the twelve sets on the charcoal block. Be sure to place the joints of the closed links in such a way that they do not touch the connecting links which are to be soldered. After soldering the sets of three links, make groups consisting of seven links by joining two sets of three with single links (Figure 8). This will make six groups of chain, which are joined as before.

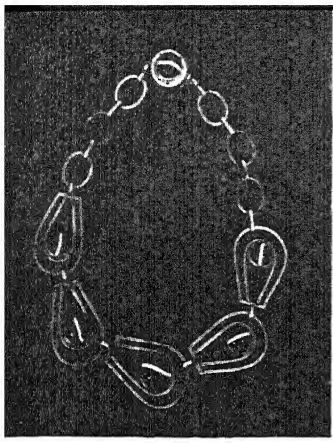


Figure 15
Necklace by Caroline Wagner.

Figure 16
Pendant and chain by a veteran.

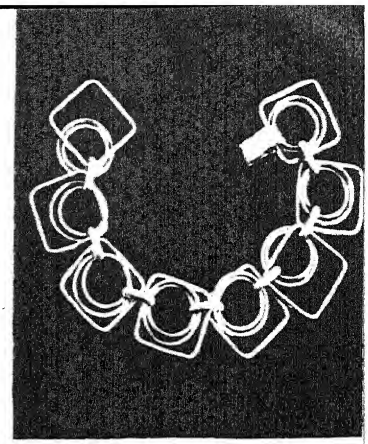
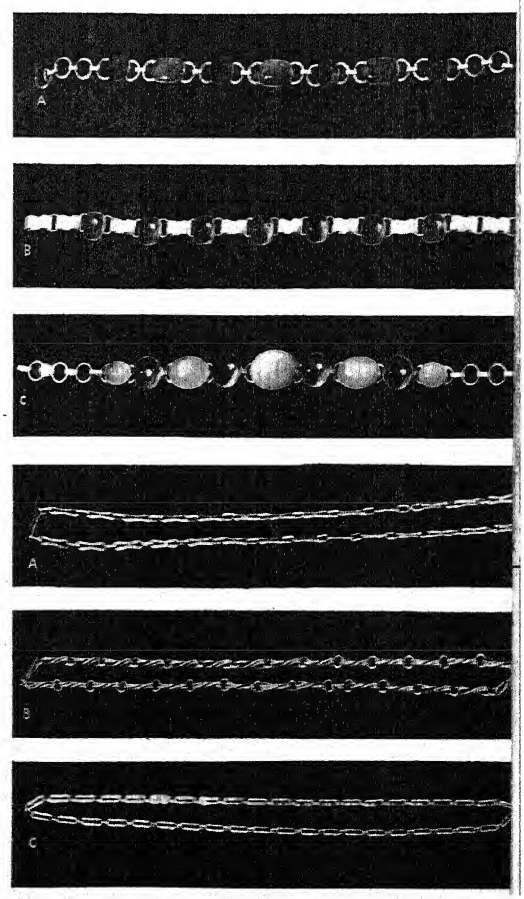


Figure 17
Bracelet by Hilda Krauss.

Figure 13 A, B, and C Chains by Madeleine Turner.



The chain now has six more links than the desired 42, but this is mathematically impossible to avoid. It is better to have too many than too few.

If in spite of the care taken in laying out the chain on the charcoal block, links tend to solder to each other, this can be avoided by painting all soldered joints with a paint made of powdered ochre and water mixed to a creamy consistency. Care, however, should be taken not to get the ochre on any parts that are to be soldered as it will hinder the soldering. It is probably advisable to do this at an early stage, when joining the sets of three links together. Still another method to prevent soldering of links to each other is to support the link to be soldered on a piece of heavy iron binding wire bent at right angles and pushed into the charcoal block in an upright position (Figure 9). The binding wire should be painted with ochre where the link is to rest to prevent the chain from soldering to it. When the soldering is completed the chain may be pickled and examined for imperfect or rough joints. Rough joints should be smoothed with needle files.

Making the Catch It now remains to make a catch. A simple catch is the ring and swivel type. This consists of a ring approximately ½" in diameter and a straight cross bar with a knob or ball on each end (Figure 10). To make the balls on the ends of the bar, dig holes like half of a ball in the charcoal block. This can be done

Figure 14 A, B, and C Chains by Madeleine Burrage.

Figure 18 Necklace by Victor D'Amico.

by rotating a sharp tool. Place two pieces of equal length of wire over the holes, paint with flux, and apply the flame until the wires melt. The melted silver will form naturally into spheres or balls.

To solder the balls to the ends of the bar, make slight depressions in the charcoal block at a distance apart equal to the length of the bar. File a slight flat section on each ball where it is to be soldered to the bar. Also file the ends of the bar. If necessary make a depression in the charcoal to prevent the bar from rolling out of position during soldering; or pin the bar with U-shaped pins made of binding wire. The balls may be held firmly against the ends of the bar by pushing a U-shaped pin vertically into the block on the outer side of each ball (Figure 11).

The large ring may be formed with pliers, by making a rough ring, soldering it and then shaping it on the ring mandrel; or it may be formed by taking one and one-half coils around a dowel whose diameter is approximately the inner diameter of the ring needed. Small circular rings should be soldered to both ring and bar. Leave the rings open while soldering to the large ring and the bar (Figure 12). After linking in the end of the chain, close the small ring and solder. Pickle the whole chain, wash, and polish (see pages 91-93). It is dangerous to polish a chain on a motor buff, as it may catch in the buff and instantly be wound around it and broken into pieces. A hand buff is recommended for polishing.

The processes described above are the simple and standard ways of making links, but variety is possible in their arrangement such as alternating or grouping links in respect to size, shape, and number. Chain can also be varied by multiple links (Figure 17), bending, or twisting the links (Figure 14A and B). While chains which support pendants or decorative central units should be simple, chains can become decorative pieces in themselves if the units and links are made important (Figure 13C), but this construction belongs more properly in the next project. Consideration at this time may, however, be an asset in preparing the craftsman for a more courageous and original approach. There are no bounds for the designer with imagination in inventing and combining links of his own (Figures 3, 15, 17 and 18).

PROJECT XVIII: UNIT JEWELRY

Necklaces, Chokers and Bracelets

Materials, Tools and Supplies: these will depend on each project chosen

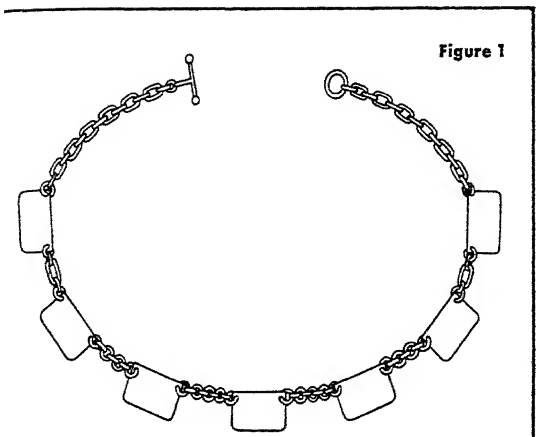


Figure 1

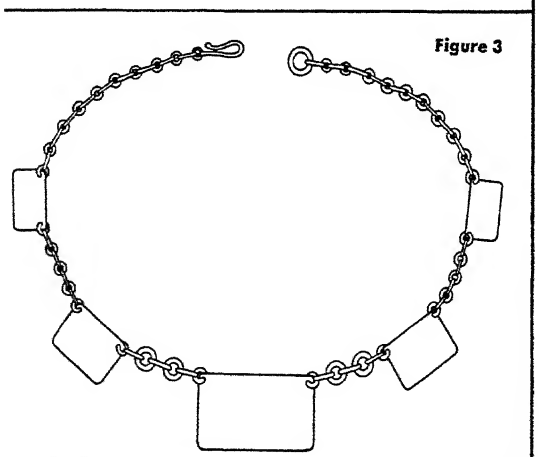


Figure 3

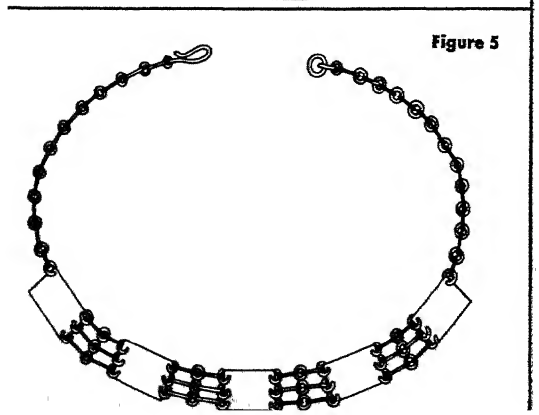


Figure 5

When you have learned the fundamental processes of jewelry making, and gained a concept of designing, you can make more complex types of jewelry, such as necklaces, chokers, and bracelets. These can be made of several units joined together. Any of the processes described in the foregoing projects can be applied, such as etching, piercing, plate on plate, repoussé, stone setting. In the interest of good design, it is advisable to keep the units as well as the whole design simple. Sometimes a beginner is tempted to demonstrate his skill by overloading or overdecorating a single piece of jewelry. It is best to spread this skill over a number of pieces. Because jewelry is worn, consideration must be given to the wearer. Some persons prefer light and delicate jewelry, others heavy and bold pieces. If you are designing for a particular person take this factor into consideration. However, if you are making jewelry just for pleasure, design it to suit your taste; you will probably have no difficulty in finding a suitable wearer for it later.

It may be assumed that if the beginner has done all of the preceding projects he will by this time have sufficient imagination and skill to work complex designs and to figure out the construction. However, some of the problems such as fitting a choker to the neck, joining the units, and other problems of designing and craftsmanship will be new to him.

DESIGNING NECKLACES AND CHOKERS

In designing necklaces and chokers of unit construction, the units may be all the same with alternating links or groups of links (Figure 1). A single unit design may be repeated, becoming progressively smaller as the units move from the center (Figure 2A and D). Notice that these are

separated by metal beads to give variation as well as flexibility to the piece. Another method is to have the units hang free from a decorative or plain supporting flexible chain or wire. These units may be the same (Figure 2C) or alternate between different units (Figure 2B). Observe that the necklaces have no units at the back, but are made up of simple chain or wire construction. This is done for the comfort of the wearer. Another method in designing is to have one dominating central unit which is repeated in character in other units (Figure 3).

Chokers are more difficult to make than necklaces because of the necessity of fitting them to the neck of the wearer. The necklace is designed to fit rather loosely around the neck with the front central part just below the pit of the neck, although it may hang lower, and therefore its length is more adaptable to necks of different sizes. For this reason it may be advisable to try a necklace first.

To obtain the length and general shape of the necklace, cut a 15" or 16" piece of wire of any kind of metal and curve it approximately to the shape shown in Figure 4. Copy the shape of the wire with pencil on paper and draw the central axis AB. The drawn curve represents the top or inner circumference line of the necklace, the decorative units being designed to hang below the line. Begin by designing the central unit. Place it below the line and on the central axis. One may begin the construction at once with the design in mind, or the design may be first sketched in pencil. It is advisable to make three or four rough trials before deciding on the final design. Plan to connect the several units by linking them together at the upper corners only. Units which are connected at both the top and bottom corners require careful planning with mechanical drawing instruments in order to have the necklace fit well around the neck. If the beginner wishes to attempt this type of necklace, he can, however, work by trial and error, making the units of cardboard and linking them together with roughly made links of heavy binding wire or thin sheet metal. Adjustments can easily be made by cutting the cardboard or shortening or lengthening the links of wire (Figure 5).

When the necklace is correctly adjusted it can be duplicated carefully in fine metals. One should not attempt too ambitious a project at the outset because he may become so involved with the technical possibilities that he loses sight of the design. It is advisable to limit oneself to the combination of flat shapes such as geometric or organic shapes joining them together with interesting links. For example, the links may be made of twisted, flattened, coiled, or other combinations of wire (Figure 6).

If the central unit is featured, there will be an odd number of units, either three, five, seven or more, an equal number being placed on either side. The central unit should predominate by being larger or having more decoration than the others, for example having a set stone. The units can be joined by specially designed links or by

Figure 4

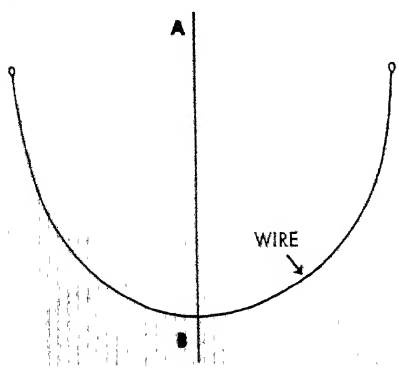


Figure 6

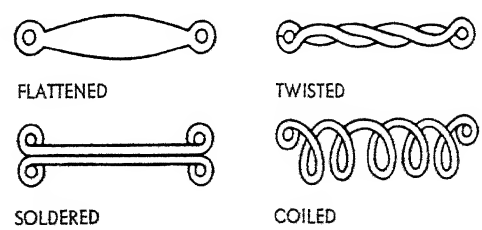


Figure 7

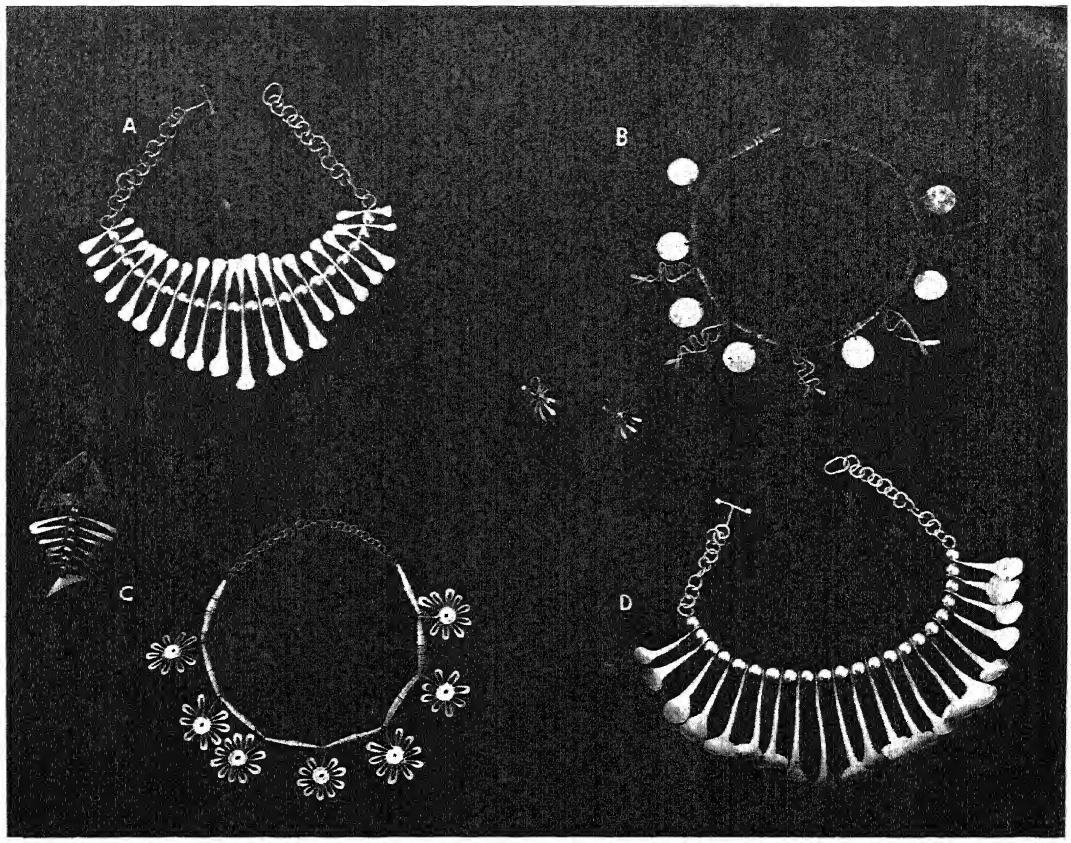


Figure 2 Modern handmade jewelry by Fred Farr.

simple round or oval links. The metals for the units and links should be a consciously planned part of the design, for example, heavy gauge plate or wire for a bold design (11 or 12 gauge) and light gauge for medium or delicate design (18 to 24 gauge). The necklace can be finished by oxidizing or left bright as the design dictates.

APPLICATION OF OTHER PROCESSES A second project may include the piercing or appliquéing of wire or plate to the face of the units or perhaps stamping a surface decoration with stamping dies. Small stones may be set on the central unit or on all of the units with appliquéd wire or plate, but one must be careful not to overdo.

THREE-DIMENSIONAL UNITS A more advanced project may be that of giving a three-dimensional quality to the units. The simplest way is to bend or shape a flat unit with pliers (see page 50), but greater emphasis on form may be achieved by shaping the units as follows: First design your necklace or choker as a whole, then transfer the unit designs by tracing them with carbon paper or glueing them on 24 gauge or some other gauge silver. Saw the units out and finish the edges; the units are now ready to be shaped. Most of the shaping can be done by hammering at the edges with a small rawhide mallet over a dowel shaped as in Figure 7. The top of the dowel can be rounded with a coarse file. Four or five dowels, depending on the complexity of the unit shapes, will be needed. Suggested sizes for a design like the one illustrated in Figure 8 are ⅜", ½", and ¾". Choose the size dowel which most nearly conforms to the varying curves on the contours of the units. Some difficulty may be encountered where there are concave curves or where there is a sharp V indenta-

tion on the contour. Such places have to be finished by placing the unit face down on a lead block and hammering the section with a ball pein hammer and dapping tool.

The units might best be joined and oxidized, leaving the oxidation in the hollows and cleaning off all high spots, but for the sake of the experience, we shall proceed to decorate them with appliquéd wire. We shall use 18 karat, 20 gauge round gold wire, but either copper or silver wire in the same gauge may be substituted. Gold wire on silver makes an attractive variation. The appliquéd wire must be in a design which harmonizes with the general shape of the unit. If we assume that the contour of the units is curved it seems necessary that the decoration also be made in curves. Straight lines would not harmonize with the general shape of the unit. A suitable design would be a wavy or spiral-shaped wire (Figure 9). Each unit will have its own wire motif, but based on the same curved rhythm. Try a sketch on paper first, tracing the contour of each unit and drawing the motif inside.

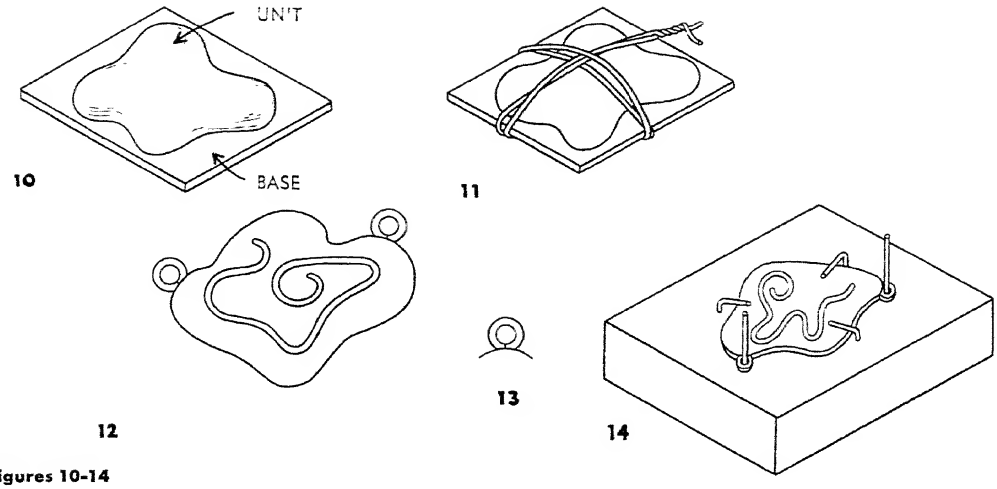
When suitable designs have been made for the wire motifs begin bending the wire with chain pliers. Anneal the wire first. The approximate length of each motif can be estimated roughly by marking off ½" lengths on the pencil sketch. When you have all the necessary wire motifs made, put each design aside with its unit. Scrape the underside of each motif and paint the scraped part with flux. With the fingers, bend each wire to conform with the dome-shaped unit, scrape the surfaces of the unit where the wire is soldered, and paint the scraped areas with flux. Bind the wire to the unit with fine binding wire as one would tie a package. The soldering may be done with silver solder, or if one wishes, it may be soldered with 10 karat gold solder. The gold solder is used in the same way as silver solder and the flux is the same.

Plan to do the soldering of all units at the same time. First dry the flux by passing the flame intermittently over all the units, then concentrate on one at a time, keeping the flame moving back and forth over the unit to prevent the solder from "balling up." Proceed with all hard soldering. When the units are cool, examine each one to see whether the wires are soldered throughout their lengths. If gaps are found, tap the wire lightly at the unsoldered section and bind the part with binding wire, paint with flux, and add more solder if necessary. Proceed to design and make the links and finish by oxidizing and polishing as you prefer (see pages 91-93).

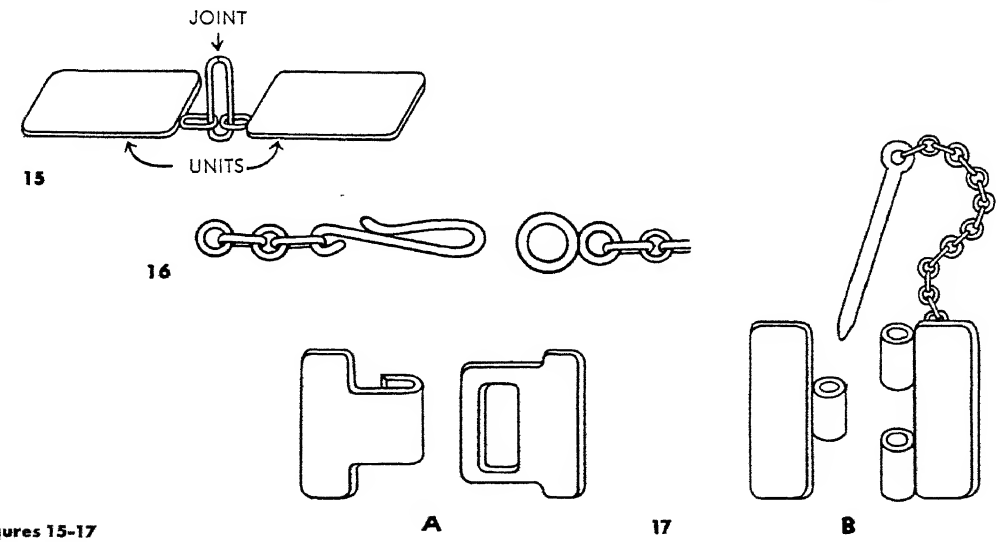
Backing Three-Dimensional Units Three-dimensional units may be backed with flat sheet silver to give them a feeling of weightiness and solidity. If they are made in light gauge metal it will help to hold their shape over a long period of time. Backing consists in soldering each unit to a flat sheet of 28 gauge silver or other metal. After you have made and shaped the units, prepare to solder them to the flat sheet base by filing the edges so that they are flat or level. This

Figure 8

Figure 9



Figures 10-14



Figures 15-17

can best be done by rubbing the units on a broad, flat, medium-cut file. Place the file on the bench and, with the fingers, hold the unit face up and rub it back and forth on the file, testing occasionally for flatness by trying the unit on a hard flat surface such as a steel plate. When the edges of all the units have been filed flat, paint each filed edge with soldering flux.

To prepare the flat bases for the units, anneal a piece of 28 gauge silver and from this sheet, using metal snips, cut a piece for each unit a trifle larger than the unit. At this stage the shape of the base piece need only approximate the shape of the unit. Place the unit on the base and with a sharp pencil trace the contour of the unit on the base (Figure 10), then scrape the metal of the base with a sharp scraper just inside the pencil line to a width of 1/16" or more. Paint the scraped area with flux. Before binding the two pieces together for soldering it is necessary to drill a small hole in the base plate to allow

for escape of air during soldering. Failure to provide an air vent may result in incompletely soldered joints and in some cases even in a small explosion. Use a #60 or #65 twist drill and place the hole at any spot on the back.

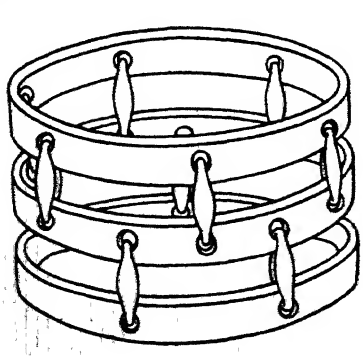
To bind the back to the unit use a fine binding wire about 22 gauge and bind as before, i. e. as one would tie a package (Figure 11). If necessary, notches may be filed on the edge of the base to prevent the slipping of the binding wire. Place solder pellets around the edge of the unit at intervals of ⅜" and apply the flame. All of the joints may be soldered at the same time. After soldering, examine all joints for flaws. If some sections of the joints have failed to solder, the cause may be lack of close contact between unit and base. If such is the case, hold the piece right side up on a flat anvil and lightly tap the unit with a rawhide mallet in the sections where the joint is open. Reflux the joint, rebind, add a pellet or two of solder and reheat the piece. When all the joints are properly soldered, remove all binding wires, but do not pickle the unit at this time. Pickling is done after links and joints are made and soldered and the piece is assembled.

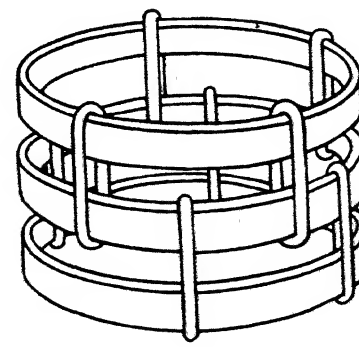
Making and Joining Links At several places in this project mention has been made of making links and joining them to the unit. On page 80 it was emphasized that the link is an important part of the necklace or choker and deserves special consideration, but the actual joining of the link was merely implied. Of course, the easiest way to join the links to units is to drill holes at the top corners of each unit, pass a link through the holes of two adjoining units and solder the link. Not all units lend themselves to this easy method. A common way is to solder round links to the top corners of each unit (Figure 12). The round links may be made of 20 or 22 gauge round silver wire. Have the inside diameter of the rings about 1/16". Follow directions for making links as described in Project XVII, page 77.

When the links are made, close each one with chain pliers and file a flat section at the joint (Figure 13). Paint the filed sections of the unit with flux. Pin the unit to a charcoal block with right-angle binding wire pins, and hold the links or rings against the unit with straight pieces of binding wire (Figure 14). If the charcoal block is large enough, do all the soldering of rings at the same time.

Chain Making Now plan the chain, its links and length, which is to complete the length of the necklace beyond the units. This is a repetition of Project XVII, but the following summary may be used as a reminder of what you learned. The chain may be made of all oval-shaped links or a combination of round and oval links. A chain made of all circular links is monotonous and looks quite commercial. A round or oval link may be used to connect the units. To solder the links which connect the units, place them as

Figure 18





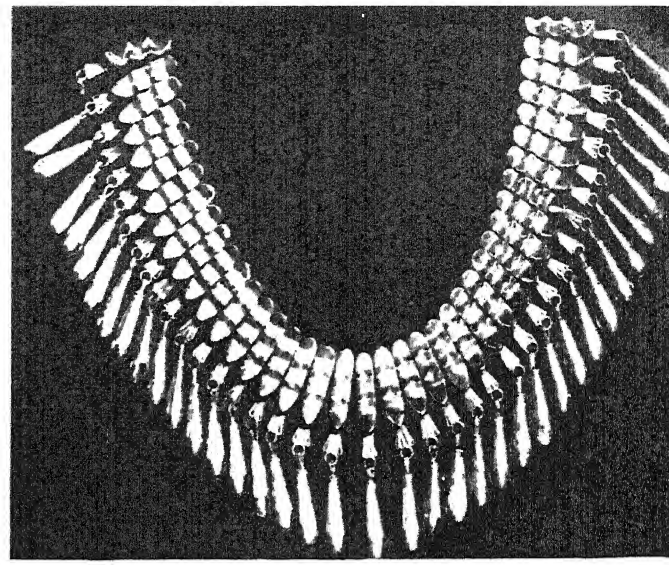


Figure 19 Gold necklace, from Mixtec burial at Monte Alban, Oaxaca, Mexico. Photo from *Medieval American Art*, by Pál Kelemen, Macmillan Co., 1943.

shown in Figure 15, with the joint of the oval link turned upward. When the chain has been made, its two end links should be soldered onto the rings of the two outer units. A catch may be made by using a heavy wire, such as 18 gauge, and forming a hook for one end and a ring for the other, as shown in Figure 16. Solder a ball on the end of the hook or hold the hook upside down with the tweezers and heat the end until it melts and runs into a ball.

It is best to do the pickling after all soldering has been completed. In the case of the necklaces with hollow units which have backs soldered to them, the pickle is inclined to work up into the hollow chamber, causing some difficulty later in removing it. To clean out the acid after pickling, boil the necklace several times in water to which a few drops of ammonia have been added. Change the water for each boiling. Dry the necklace by warming it on a hot plate or by heating the units a little with a blowtorch. It is important that all traces of pickle be removed from the hollow chambers. If the pickle remains in the unit it is apt to etch holes by working through the soldered joints or through the metal itself.

After the pickling operation the necklace should be examined and all roughness at the soldered joints should be removed with needle files. Finish the edges by rubbing them on emery cloth and emery paper. The necklace may be oxidized or left bright, then polished. It should not be polished on the motor buff because of the danger of its catching in the wheel and being broken.

A good finish for a necklace would be to give it a thorough rubbing with pumice and water spread on a piece of cloth after it is oxidized. Wash off all traces of pumice by brushing under running water. Both units and chain can be polished by rubbing with a chamois hand buff charged with polishing rouge. In polishing oxidized pieces with appliquéd wires or plates try not to polish the silver surface of the unit.

Bracelets Bracelets are made in the same way as necklaces or chokers. They can be made of flat or three-dimensional units linked together at the upper corners or made to dangle from a flexible chain or wire. In the case of a wide bracelet with parallel units, the units should be linked at top and bottom and at the center if necessary. In all cases the catch should be a secure one. The ones shown in Figure 17 are a few that have been found practical and are easily made. Interesting slip-over-the-wrist bracelets can be made by linking large rings together in ingenious ways (Figure 18).

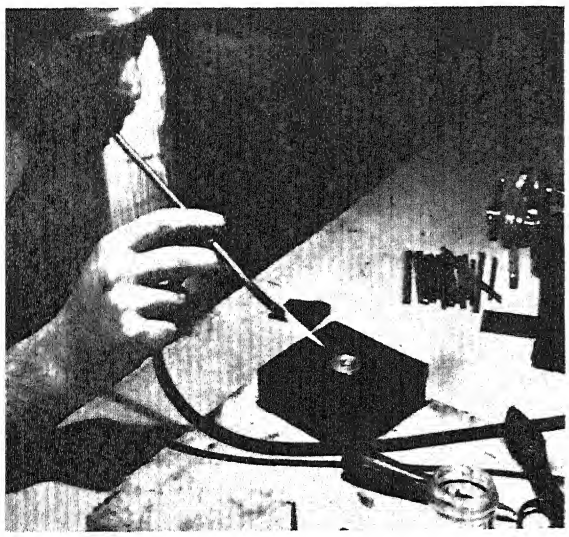


Figure 1

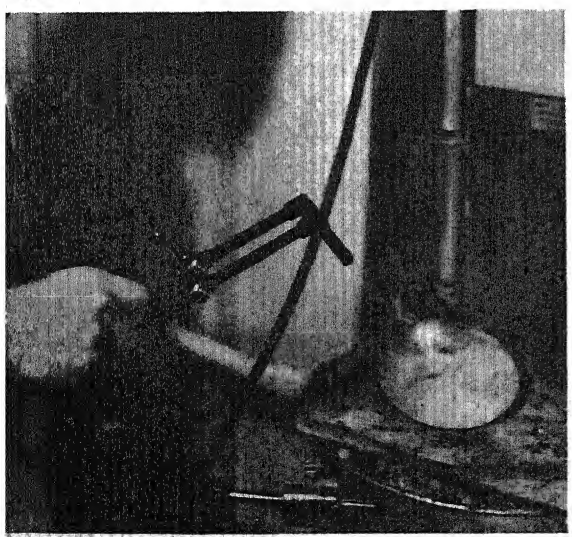
ALLOYS

When metals are added to other metals during the molten state the resulting metal is known as an "alloy." With the exception of platinum, the precious metals—silver and gold—are rarely used in the pure state for the making of jewelry.

Pure silver is called fine silver. Sterling silver is about 925 parts of fine silver with 75 parts of copper per thousand.

Pure gold is known as 24 karat. By adding different metals, such as copper, silver, or platinum, in varying quantities, different karat golds and different colors are obtained. Gold is designated by karats, depending on the proportions of metals used in relation to the 24 karats of pure gold. Gold alloys are made in karats as follows: 22, 20, 18, 14, and 10. Any alloy less than 12 karats has less gold than some other metal in its composition. The low karat alloys are used as solder for the higher karat alloys.

Figure 2



ANNEALING

Tools and Supplies: **blowtorch, blowpipe, or Bunsen burner; charcoal block; asbestos block**

Annealing is the process of softening metals through heating them. Alloys of metals such as gold, silver, and copper are made hard and brittle by rolling, hammering, or drawing (wire). In order to soften them and make them ductile, they must be heated to a dull red. For small work such as rings and bracelets of wire, a mouth blowpipe is used (Figure 1), or a Bunsen burner (see Project XII, Figure 5); but for large pieces made of plate a blowtorch is needed (Figure 2).

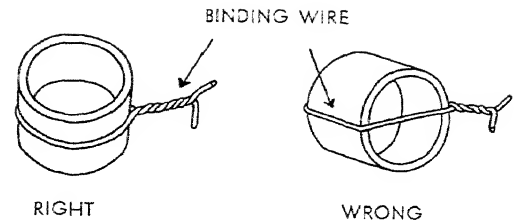


Figure 3 **Figure 4**

When annealing always pass the flame over the whole piece, heating it evenly. Concentrating on one spot is apt to burn or melt the metal. Always place the piece to be annealed on a charcoal block, which in turn should rest on an asbestos block. After heating, the metals may be left to cool naturally or be dipped into water. If metals are not kept soft during shaping or bending, they are liable to break or crack.

HARD SOLDERING

Tools and Supplies: **files; scraper; flux brush; pliers; metal snips; blowtorch, blowpipe, or Bunsen burner; flux, liquid, paste, or borax and borax slate; binding wire 14, 16, 18, 22 gauge; charcoal block; asbestos block; silver solder, easy-flowing, medium, hard**

Hard soldering, or silver soldering, is a method of joining silver, copper, and various other metals by means of a silver alloy which melts at a lower temperature than the metal or metals to be joined. For example, the melting point of sterling silver is 1640° F., whereas the melting point of easy-flowing solder is 1325° F. The melting point of copper is higher than that of sterling, so that hard soldering is often used to make joints on copper.

Hard solder makes a very strong joint. It may be obtained in sheet, pellet, or wire form and in different degrees of melting temperature. The commonly used grades are easy-flowing, medium, and hard, although most projects can be soldered with two grades only, easy-flowing and hard. The sheet form in 28 gauge is used by most craftsmen. There should be some means of identifying the different grades of solder; one is to scratch the words, "easy" and "hard," on the respective grades with a scriber or graver.

Hard soldering involves the following operations:

Filing and Cleaning of Joints and Contact Points All joints should be filed, as in fitting rings and bracelets. Where no fitting is involved, such as wire soldered to backgrounds, plate on plate, or wires soldered to each other, contact points should be scraped to insure cleanliness. It is important to keep joints and contact points clean after filing or scraping. Even the touch of fingers may prevent the flow of solder due to the oil from the skin.

Fluxing The fluxing of joints consists of coating all joints to be soldered with flux. A special small brush is reserved for this purpose. The flux commonly used is an especially prepared borax in lump or stick form, which the worker grinds in water on a special borax slate to the consistency of thick cream. Other types of flux are in liquid and paste form, they are obtainable at jeweler's supply houses and are as good as prepared borax. The purpose of the flux is to prevent the oxidizing of the metal at the joint, and to promote the flow of the solder.

Binding Some projects require that the parts be bound together before heat is applied. This is done with a special iron binding wire which

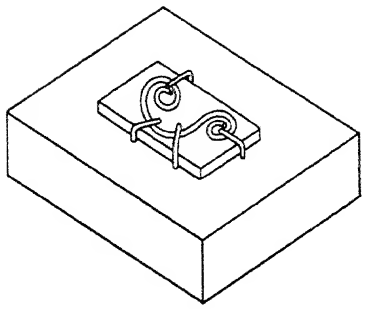


Figure 5

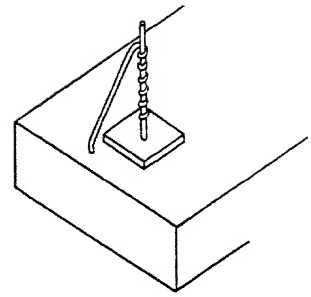


Figure 6

Figure 7

withstands high temperatures, and is less liable than other kinds of wire to solder to parts of the joint which it might touch. Useful gauges are 14, 16, 18, 22.

While there are many commonly used methods of binding practiced by experienced craftsmen, some projects demand different and ingenious methods of binding. In every case it is well to anticipate what will happen during the heating of the piece. A binding which seems good when cold may result in distortion of the piece during heating. Figures 3 and 4 illustrate improper and proper ways of binding for soldering the joint on a ring.

Figure 5 illustrates another method of binding, that is, by pinning the whole project to a charcoal block and at the same time pinning the parts to the metal sheet. Right-angle pins are made of 14 or 16 gauge iron wire (see page 26). When cutting off the lengths of iron wire, of which the pins are made, cut at a long angle in order to form points on the pins which will facilitate pushing them into the charcoal block. Figure 6 illustrates a method of holding parts on pins perpendicular to a piece while soldering.

Applying Solder Hard solder is usually applied in the form of small pellets. To prepare the solder pellets, clean a small section of one end of the sheet solder by scraping it with a scraper or a file. With snips make many cuts on the cleaned end of the strip, having the cuts run parallel to the long side, then make cuts across the first cuts (Figure 7). Let the pellets drop into the borax slate or onto a clean piece of paper. They should be approximately 1/16" x 1/12". Using a flux brush which has been dipped into flux, pick up the pellets one at a time and place them at the joint. The number of pellets required and their distribution is determined by the area of the joint. For the average joint a ⅜" spacing is about right.

Heating The flame generally used for soldering is a mixture of some kind of gas with a stream of air from a blower or compression tank. It is important to adjust the mixture so as to produce a soft blue flame. A yellow flame indicates not enough air, while a flame which roars indicates too much air. The hottest part of the flame is at its outer end, that is, the end farthest from the nozzle of the blowtorch. For small work a combination blowpipe may be used. This is a tapered tube, usually made of brass with an opening on the side designed for the attachment of a rubber tube which supplies the gas. The large end of the blowpipe is placed between the lips of the worker who, by blowing through the tube, supplies the air necessary to produce a blue flame (Figure 1). A Bunsen burner also may be used for soldering small projects. The work is always placed on a charcoal block which increases the heat, but this block must be placed

on an asbestos block to prevent the table from catching fire.

Bringing the piece to soldering heat requires good judgment. In applying the heat, the first stage is the drying and melting of the flux. If this is done too rapidly, the drying flux may push the pellets away from the joint. Pass the flame rapidly over the piece and as quickly remove it. Repeat this operation until the flux looks somewhat whitish, at which time the heat may be applied more continuously. The beginner usually has the mistaken idea of trying to melt the pellets of solder by directing the flame at them, but rather the aim should be to bring the metal to soldering temperature by directing the flame in the beginning at the weightier or larger parts of the piece. If the flame is directed at the pellets they may "ball up" and fail to flow. This indicates that the solder has melted but that the metal at the joint is too cold to accept the fluid solder, and the solder forms into a tiny sphere. When this happens, reflux the joint and apply new solder. If the soldering is successful, allow the piece to cool and remove all binding wire. After all soldering is done the piece should be pickled.

OXIDIZING

Tools and Supplies: **copper tweezers or tongs; liver of sulphur; Pyrex dish; pumice; brush**

Oxidizing produces a black coating over silver and copper which is later rubbed off on the high parts to accent the form. To oxidize silver or copper, dissolve a lump of "liver of sulphur" (potassium sulphide) about the size of a hazelnut in a cup of water. The action may be hastened by heating in a porcelain, Pyrex, or enameled vessel. NEVER USE ONE MADE OF COPPER. The solution can be used cold, but is more effective when used hot—not boiling. The piece may be colored by successive brushings, or by immersing in the solution. When the desired color is obtained, drop the piece into water and then dry.

To remove the color where it is not desired, rub the piece with wet pumice powder either on the fingers or on a cloth. Tripoli powder may be used instead of pumice. Brush off with a soft brush under running water.

PICKLING

Tools and Supplies: **copper tongs; brush; pickle; copper pickle pan; dish of water**

"Pickle" is the worker's term to designate an acid cleaning solution used to dissolve the oxide scale which forms during and after the heating of gold, silver or copper alloys. Pickle also dissolves any excess flux which may remain after soldering.

To make pickle: pour 1 PART of sulphuric acid into 15 PARTS of water. ALWAYS POUR THE ACID INTO THE WATER. Pouring water into acid may cause an explosion.

Pickling may be accomplished in a cold solution, but heating the solution speeds the process. Pickling in cold solution requires about twenty minutes; in hot solution about three to five minutes. When heating pickle, use only a copper pickle pan or a Pyrex dish. DO NOT BOIL. Be sure that there are no particles of iron binding wire on the piece as it will give the surface a pinkish cast which is difficult to remove. After pickling, remove from pan with copper, brass, or silver tongs and drop into water. Never use iron or steel instruments. Brush the piece with a soft brush under running water. If stains still remain use pumice powder on the brush.

In general, pickling should not be done until all soldering is completed, as it lessens the chance of success in cases where joints require resoldering. When the pickle becomes concentrated through constant heating, add water.

Pickle should be kept in a labeled bottle when not in use. It may be used over and over for quite a long time.

POLISHING

Tools and Supplies: **felt hand buff; chamois hand buff; motor buff with one muslin and one flannel buff, one inside ring buff, one hard felt buff, and one soft felt buff; needle and riffle files; #3/0 emery cloth; #3/0 emery paper; Scotch stone; pumice; fine steel wool; tripoli; brush; rouge; cloth**

Polishing is the final stage in the making of jewelry. The surface of gold, silver, copper and some other non-ferrous metals, if properly prepared, may be polished to a mat or high polish. Polishing may be done by hand or by motor buff. The motor buff saves time and labor, but is not absolutely essential. Polishing is as important a part of the design as the shape or form and should be studied from the standpoint of how it will best enhance the piece.

Some pieces of jewelry require a high polish while others demand a dull or mat finish. The beginner is often tempted to over-polish his jewelry, achieving a glittering finish which may detract rather than add to his work. This is especially true in using the motor buff if it is used too long or too hard. The right finish, whether a high polish or a dull finish, or something in between, requires good judgment to reveal all of the beauty of the piece and give it the handmade quality which is so desirable in jewelry.

Preparing the Metal for Polishing Before the polishing can be done the metal should be made as free from scratches as possible. Pieces made of wire may be prepared for polishing simply by rubbing them with finishing paper, #3/0 emery paper. The preparation of sheet metal is a more involved process, especially where sections of the surface have been filed or scraped to remove solder or deep scratches.

The principle involved in all finishing of surfaces is that of beginning with a coarse abrasive, and going step by step, through medium, to fine abrasives. The order of procedure is as follows: First, file with finely cut files, such as needle or riffle files. Needle files have long blades—triangular, half-round, round, flat, etc., and are made to file planes and curved shapes or edges. Riffle files have curved ends of different shapes made to get into small places, as under an appliquéd wire. File in one direction as much as possible because when you cross-file, scratches are made that are difficult to remove. Second, remove the file marks by rubbing with Scotch stone and water. Third, rub the areas with a cloth dipped first in water and then in powdered pumice. For areas which cannot be reached in this way, rub with a soft stick of wood, sharpened or shaped to fit the areas to be smoothed, and charged with a mixture of pumice and water.

Mat Finishes If a mat finish is desired the surface is left with the pumice and water finish, or the pumice stage may be followed by a rubbing with fine steel wool for a satin mat finish.

High Polish For a high polish follow the procedure described above by rubbing the surfaces with #3/0 emery cloth and #3/0 emery paper. Now begin the polishing. If a motor buff is not available, the polishing may be done with hand buffs. A hand buff is nothing more than a flat stick, about one foot long, on which is glued a piece of felt or chamois covering about one-half its length. For the first stage in polishing use a felt hand buff, charged with stick tripoli, which is a finely powdered clay-like material mixed with oil and pressed into the form of a stick. This makes a fine abrasive. Charge the hand buff by rubbing the tripoli stick on the felt. The hand buff is used by rubbing the felt on the piece with a forward and backward movement. After using the tripoli buff, wash the piece with a brush and soap in hot water to remove all traces of the tripoli. The last stage requires a chamois hand buff charged with stick polishing rouge, used in the same way as the tripoli buff. When a high polish has been obtained, wash the piece as before with soap and hot water.

When polishing with a motor buff, the same principles are followed as in finishing and polishing by hand. The difference between hand buffing and buffing by motor lies in the great

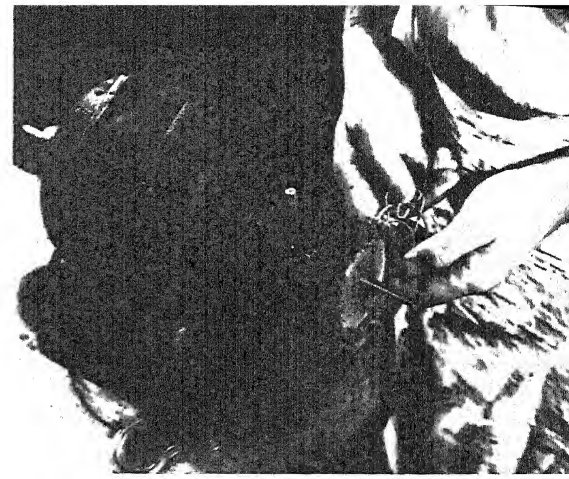


Figure 8

variety of shapes and kinds of wheel buffs which are available for the motor. There are hard felt buffs, soft muslin and flannel buffs made up in layers, buffs shaped like a finger to polish the inside of rings, buffs with bristles shaped for polishing the inside of hollow pieces, brass and steel wire brushes for scratch finishes, and many other types made for a great variety of purposes. It is not necessary to own a complete set of wheel buffs. One muslin and one flannel buff, one inside ring buff, one hard felt buff, and one soft felt buff will be sufficient for most projects. The motor buff is simply an electric motor of about ⅛ horsepower with tapered and threaded spindles on each end of the main spindle (Figure 8). The buffs are screwed onto the spindle by hand. The spindle revolves toward the operator. The left-hand spindle has a left-hand thread, therefore the buff for that side should be screwed onto the spindle with a counterclockwise direction. The threads are arranged in this manner to prevent the buff wheels from unscrewing while the motor is rotating.

One set of buff wheels should be charged with tripoli only, and one set with rouge. Tripoli is an abrasive, while rouge is a polish, and to mix the two on one wheel would ruin it either for tripoli or for rouge. It is suggested that tripoli be used on muslin and hard felt, and rouge on the others.

On smooth unbroken surfaces use a felt wheel charged with tripoli. Charge the wheel with tripoli by holding the stick against it for a few seconds while it is revolving. Hold the piece in the fingers and press firmly against the wheel below the center, or spindle, as it revolves. Move the piece around in the fingers until all parts have been in contact with the wheel. For average pieces, from five to ten minutes at the wheel is sufficient for the preliminary polish. To polish an irregular surface, such as an appliquéd wire decoration or plate on plate, a wheel should be chosen which has a soft flexible outer circumference. A muslin wheel is the right type for irregular surfaces.

In polishing a pin with a pin tong be sure that the pin tong is engaged with the catch. An unengaged pin tong is liable to catch in the wheel with resulting damages to both the piece and the operator. The best way is to polish the back of the pin before the pin tong is riveted in place. A long exposure to the tripoli wheel may reduce both pin tong and catch in size or completely cut them away.

After the preliminary polish with tripoli, remove all traces of it by washing the piece with a brush and soap and hot water as was done when using the hand buff. Use a flannel wheel charged with rouge for the final polish. After polishing, wash the piece again with a brush, soap, and hot water.

Caution: DO NOT try to polish very delicate pieces, or pieces with sharp points on the motor buff, as they are apt to be damaged. Above all, chains, necklaces, or chokers should never be polished on the motor buff because they will be caught in the wheel and destroyed with possible injury to the worker. These may be polished by rubbing them with a chamois skin charged with rouge, or by polishing them with the hand buff, then washing in soap and hot water. The edges of pieces made of sheet metal may be polished on hard felt wheels charged with rouge.

If You Want to Build Your Own Jeweler's Work Bench

It is not necessary to have a work bench to make jewelry. Any convenient table, a kitchen table, will do. You can purchase a combination bench pin and anvil which is held to the table top by a clamp and thumb screw (Figure 1). Below are suggestions for a work bench designed for the home workshop (Figure 2).

The bench may be worked out in correct proportions to insure good, comfortable posture and free movement for arm and shoulder muscles. Its construction should be sturdy, any wood available in your locality may be used, but hard wood is recommended for the top working surface and bench pin. It can be made collapsible by putting it together with screws. It should be small enough to fit easily into the corner of a room or basement, yet contain the following essentials of a good work bench:

adequate working space

a drawer making often-used tools readily accessible

sliding tray to catch filings to save for refining.

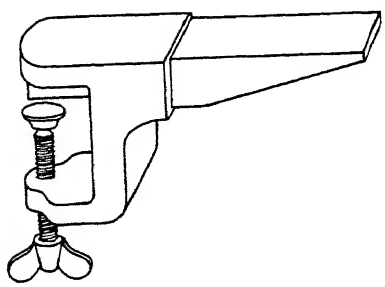


Figure 1 Combination bench pin and anvil.

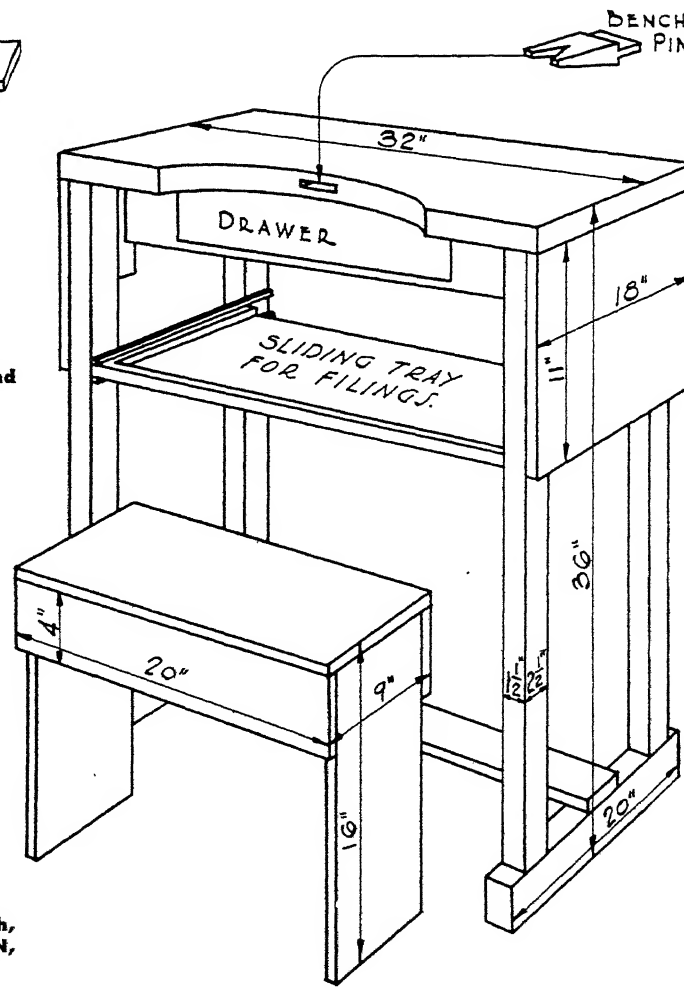


Figure 2 Design for a work bench, from SILVER FOR THE CRAFTSMAN, courtesy of Handy and Harman.

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